



*Pacific Gas and
Electric Company*®

Pacific Gas and Electric Company 2019 Wildfire Safety Plan

February 6, 2019

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Attachments:

- A: Fire Potential Index Methodology and Background**
- B: Critical Services**
- C: Description of Routine Facilities Inspections**
- D: Risks and Drivers Identified in RAMP**
- E: Cost Estimates for 2019 Plan Programs**

Glossary of Acronyms and Abbreviations

Acronym	Term/Definition
AHJ	Agency Having Jurisdiction
ALJ Ruling	<i>Administrative Law Judge's Ruling on Wildfire Mitigation Plan Template, And Adding Additional Parties as Respondents</i> , issued January 17, 2019 in R.18-10-007
CAL FIRE	California Department of Forestry and Fire Protection
Cal OES	California Office of Emergency Services
CARE	California Alternate Rate for Energy
CEMA	Catastrophic Event Memorandum Account
CEQA	California Environmental Quality Act
CERP	Company Emergency Response Plan
CIRT	Centralized Inspection Review Team
CPUC or Commission	California Public Utilities Commission
CWSP	Community Wildfire Safety Program
D.	Decision
DFM	Dead Fuel Moisture
EAM	Electric Asset Management
EEI	Edison Electric Institute
EOC	Emergency Operations Center
EP&R	Emergency Preparedness and Response
EPIC	Electric Program Investment Charge
ESA	Energy Savings Assistance
ETOR	Estimated Time of Restoration
EVM	Enhanced Vegetation Management

Acronym	Term/Definition
FIA	Fire Index Area
FMEA	Failure Modes and Effects Analysis
FPI	Fire Potential Index
FPP	Fire Prevention Plan
GO	General Order
GRC	General Rate Case
HFTD	High Fire-Threat District
HHZ	High Hazard Zones
IBEW	International Brotherhood of Electrical Workers
ICS	Incident Command Structure
IOU	Investor-Owned Utility
IVR	Integrated Voice Recording
km	Kilometer
kV	Kilovolt
MAA	Mutual Assistance Agreements
mph	miles per hour
NWS	National Weather Service
OA	Operability Assessment
OEM	Original Equipment Manufacturer
OES	Office of Emergency Services
OP	Ordering Paragraph
PEV	Post Enrollment Verification
PG&E or the Company	Pacific Gas and Electric Company

Acronym	Term/Definition
PIH	Pre-installed Interconnection Hubs
Plan	Wildfire Safety Plan
POMMS	PG&E Operational Mesoscale Modeling System
PRC	Public Resources Code
PSPS	Public Safety Power Shutoff
PUC	Public Utilities Code
QA	Quality Assurance
QC	Quality Control
QM	Quality Management
R.	Rulemaking
RAMP	Risk Assessment and Mitigation Phase
REACH	Relief for Energy Assistance through Community Help
ROW	Right-of-Way
SB 901	Senate Bill 901
SCADA	Supervisory Control and Data Acquisition
SDG&E	San Diego Gas & Electric
SIPT	Safety and Infrastructure Protection Teams
SMAP	Safety Model Assessment Proceeding
SMEs	Subject Matter Experts
SmartMeter™	Brand Name for Automated Metering Initiative (AMI)
SOPP	Storm Outage Prediction Model
T&D	Transmission and Distribution
U.S.	United States

Acronym	Term/Definition
USFS	United States Forest Service
VM	Vegetation Management
VP	Vice President
WSIP	Wildfire Safety Inspection Program
WSP or Plan	Wildfire Safety Plan
WSOC	Wildfire Safety Operations Center

1. Introduction and Objectives of Plan

1.1. Executive Summary

Pacific Gas and Electric Company (PG&E or the Company) takes seriously the critical role it plays in preventing wildfires caused by electrical equipment in Northern California. We understand the urgency of the situation, that lives could be at stake and that we need to move even more quickly. This Wildfire Safety Plan (WSP or Plan) describes the enhanced, accelerated, and new programs that PG&E is and will aggressively continue to implement to prevent wildfires in 2019 and beyond. To address increasing wildfire risk, in addition to aggressively implementing new approaches to manage it, PG&E believes shutting off power will likely be necessary and may need to be performed more frequently due to the extreme weather events and dry vegetation conditions. To that end, PG&E is expanding its Public Safety Power Shutoff (PSPS) program to prevent wildfires from occurring and is implementing new ways to reduce its impacts to first responders and vulnerable customers, including those with medical needs.

PG&E submits this Plan pursuant to Senate Bill (SB) 901 requiring all California electric utilities to prepare plans on constructing, maintaining, and operating their electrical lines and equipment to minimize the risk of catastrophic wildfire. The California Public Utilities Commission (CPUC or Commission) established a schedule for submission and review of the initial wildfire mitigation plans, and a process for review and implementation of plans to be filed in future years. PG&E is providing this Plan consistent with the statutory requirements and direction provided by the CPUC in its *Order Instituting Rulemaking to Implement Electric Utility Wildfire Mitigation Plans Pursuant to Senate Bill 901 (2018)*, Rulemaking (R.) 18-10-007 (Wildfire OIR).

This Plan describes PG&E's proposed programs and strategies, recognizing that it will take a major collective effort to prevent wildfires. We welcome the input and feedback of our communities, customers, community leaders, first responders, and others to collaboratively solve the unprecedented wildfire risk facing our state.

Filing this Plan is an important milestone. But PG&E has not been waiting for regulatory action. Instead, since the October 2017 North Bay wildfires and the 2018 Camp Fire, PG&E has proactively implemented enhanced wildfire safety programs with urgency. In this Plan, PG&E describes the actions we have already taken, and the actions we intend to take, to prevent wildfires in 2019 and beyond. Preventing wildfires outright is likely impossible. However, PG&E is approaching the issue with urgency to do everything we can to prevent our facilities from creating public safety risks. PG&E's efforts include significant expansions in its PSPS program and its situational awareness capabilities, vegetation management, inspections of electric distribution and transmission facilities, system hardening, enhanced controls, and other programs designed to make PG&E's customers and the communities that we serve safer. In designing this approach, PG&E benchmarked with several utilities including San Diego Gas & Electric Company (SDG&E) and several Australian utilities, with variations that reflect differences in our territory or system design.

This work is inherently hazardous and must be done safely, with quality and care. There are execution risks to accomplish the expanded and accelerated scope of work planned by PG&E. The availability of equipment, qualified personnel, and legal/regulatory issues (such as land rights and environmental permitting requirements) can impact the timing and scope of the programs proposed in this Plan. As described more in Section 4 below, PG&E intends to work aggressively to resolve these execution risks as they arise, including working with existing contractors and suppliers to increase available resources as quickly as possible. Going forward, PG&E will continue to enhance and build upon these programs as we learn from our experience and our collaboration with customers, communities, and industry experts.

Table 1 below provides an overview of PG&E's wildfire reduction measures, followed by a summary narrative, describing PG&E's 2019 wildfire related programs.

TABLE 1: 2019 PROGRAM OVERVIEW¹

Wildfire Reduction Measure	2018 (Approx.)	2019 (Approx.)	Percentage/ Capacity Increase (Approx.)	2019 Planned Work Completion by June²
Vegetation Management ³	160,000 trees removed	375,000 trees removed	235%	42%
	760 miles of fuel reduction, overhang clearing, or Enhanced Vegetation Management (EVM)	2,450 miles of EVM	320%	40%
Inspections - Distribution	517,500 distribution poles for routine inspections	685,000 distribution poles in High Fire Threat District (HFTD) areas with enhanced inspections in five months <u>in addition to</u> routine inspections	130% -400% (excluding substations)	100%
Inspections - Transmission	9,400 transmission structures with enhanced inspections 76,000 routine inspections of transmission structures	40,600 transmission structures with enhanced inspections ⁴ in four months <u>in addition to</u> routine inspections		100%
Inspections - Substations	960 monthly routine inspections	200 enhanced risk-based inspections in the HFTD areas in four months <u>in addition to</u> routine, monthly inspections		100%
System Hardening ⁵	17 circuit miles-tree wire projects	150 circuit miles	880%	30%

¹ Numbers in Table 1 are approximated for purposes of presentation in this table.

² Completion dates are current estimates and may change depending on external factors such as the availability of equipment and qualified personnel, including third-party vendors and suppliers, as well potential legal or regulatory challenges to tree removal, vegetation management, and system hardening.

³ Includes trees removed under PG&E's Drought and Tree Mortality work vegetation management (CEMA) work, accelerated wildfire risk reduction vegetation management (AWRR), and EVM for 2018 and CEMA and EVM for 2019.

⁴ Including drone and helicopter inspections and climbing of all transmission towers.

⁵ With the exception of light-duty steel poles, the System Hardening work will be performed for distribution.

**TABLE 1: 2019 PROGRAM OVERVIEW⁶
(CONTINUED)**

Wildfire Reduction Measure	2018 (Approx.)	2019 (Approx.)	Percentage/ Capacity Increase (Approx.)	2019 Planned Work Completion by June⁷
Situational Awareness	200 weather stations	400 additional weather stations	200%	50%
	9 cameras	70 additional cameras	780%	42%
	N/A	Developing fire spread model capabilities – Phase 1 ⁸	N/A	100%
Resilience Zones	N/A	At least 1 resilience zone operationalized	N/A	N/A
PSPS	7,100 distribution circuit miles in Program (Tier 3 HFTD areas)	25,200 distribution circuit miles in Program (Tier 2 and Tier 3 HFTD areas)	355%	100%
	370 circuit miles of transmission lines at 70 kilovolt (kV) and below	5,500 circuit miles of transmission lines at 500kV and below	1,485%	100%
	570,000 electric customer premises potentially impacted by PSPS events	5.4 million electric customer premises potentially impacted by PSPS events	950%	100% ⁹

The following summary narrative describes in more detail PG&E's wildfire reduction programs and measures:

- Vegetation Management:
 - Expanded Removal of Trees: PG&E forecasts removing approximately

⁶ Numbers in Table 1 are approximated for purposes of presentation in this table.

⁷ Completion dates are current estimates and may change depending on external factors such as the availability of equipment and qualified personnel, including third-party vendors and suppliers, as well potential legal or regulatory challenges to tree removal, vegetation management, and system hardening.

⁸ Phase 1 includes modeling asset fire spread risks for overhead lines in Tier 2 and Tier 3. Later phases include more granular analysis and refined outputs.

⁹ All 5.4 million electric customer premises to be notified of the potential for PSPS impacts by June 2019.

375,000 trees in 2019 that have a higher potential to fail including at-risk species in addition to dead, dying or other hazard trees.

- Enhanced Vegetation Management: PG&E will perform EVM on approximately 2,450 circuit miles in HFTD areas by the end of 2019, including targeted removal of vegetation fuels under and adjacent to power lines.
- Inspections:
 - Expanded Inspections: By May 31, 2019, PG&E will perform enhanced inspections of its electrical assets in HFTD areas, including approximately 685,000 distribution poles, 50,000¹⁰ transmission structures, and 200 substations. These enhanced inspections include ground inspections, drone and helicopter inspections where needed, and climbing inspections of every transmission tower.
 - Corrective Actions: PG&E will take immediate action to address any issues identified as an imminent risk to public or employee safety.
- System Hardening: System hardening reduces potential fire risk associated with the overhead distribution system and includes replacing bare overhead conductor with covered conductor, select undergrounding where appropriate, replacing equipment with equipment identified by the California Department of Forestry and Fire Protection (CAL FIRE) as low fire risk, upgrading or replacing transformers to operate with more fire-resistant fluids, and installing more resilient poles to increase pole strength and fire resistance.
 - 2019: PG&E will complete approximately 150 miles of hardening the highest risk circuits in HFTD areas in 2019.
 - Beyond 2019: PG&E will be hardening 7,100 circuit miles in HFTD areas that it has identified through ignition modeling and field analysis as the highest risk. The pace of hardening will accelerate as PG&E aggressively works to resolve supply and qualified personnel challenges.
- Situational Awareness: PG&E is swiftly increasing its situational awareness—its knowledge of local weather and environmental conditions—to obtain real time information on a more granular level. This type of information is critical for both wildfire prevention and PSPS events, and is accessible to respective fire response agencies.
- Enhanced Controls:
 - Reclosers: In 2019, PG&E will add Supervisory Control and Data Acquisition (SCADA) capability to allow for remote reclose blocking. The expanded SCADA capability will enable remote operation of 100 percent of the line reclosers in Tiers 2 and 3 HFTD areas by June 1, 2019.

¹⁰ Inclusive of 9,400 inspections completed in December 2018.

- Additional Measures: PG&E has introduced other measures to prevent potential ignitions, including strengthened personnel work procedures, deploying Safety and Infrastructure Protection Teams (SIPT) with fire-fighting capabilities, and operating heavy-lift helicopters for enhanced fire suppression and restoration efforts, available at CAL FIRE's discretion. These measures will be in place by June 1, 2019.
- Public Safety Power Shutoff:
 - Program Initiation (2018): PG&E implemented its PSPS Program to proactively de-energize lines that traverse Tier 3 HFTD areas under extreme fire risk conditions in 2018. To develop the PSPS Program, PG&E worked extensively with SDG&E to understand and implement best practices from SDG&E's de-energization program, while addressing unique issues presented by PG&E's service area (which differs in terrain, weather, and population).
 - Program Expansion and Criteria Evolution (2019): PG&E is significantly expanding the PSPS program scope to include high voltage transmission lines and the highest fire risk areas (Tier 2 (elevated fire risk) and Tier 3 (extreme fire risk)) as referenced in the HFTD Map adopted by the CPUC. In addition, PG&E is further evaluating its PSPS decision criteria to reduce the level of judgment in the criteria to the extent feasible.
 - Working with Customers: PG&E will be working with customers to provide them with information regarding PSPS events generally, and to provide the most up to date information before and during PSPS events. This includes alerting 5.4 million PG&E electric customer premises of the potential for PSPS events. Extensive customer outreach will begin in the first quarter of 2019 and will continue throughout the year. To the extent possible, PG&E will alert customers that a PSPS event could occur within 48 hours. PG&E is actively exploring and developing additional services and programs to support our customers during PSPS events with a focus in the short term on customers who require a continuous electric supply for life support, as well as critical services (i.e., first responders, hospitals, telecom, and water agencies).

1.2. Plan Overview and Objectives

PG&E's Plan details the aggressive steps that it is taking, and will continue to take, to address the urgent need to prevent wildfires. PG&E will submit its Plan to the Commission annually for review and approval. PG&E expects the Plan will evolve over time as PG&E receives new information, more experience, and input from our communities, first responders, regulators and others through this proceeding and other venues, on how PG&E can best prevent wildfires and improve the overall safety of its

system. In addition to receiving feedback and input through the regulatory process, as part of our collaborative efforts to address the risk of catastrophic wildfires, PG&E is partnering with industry and academic experts. These partnerships, which are described in more detail in Sections 3 and 4, allow PG&E to leverage state-of-the-art thinking in fields that range from wildfire evacuation to probabilistic risk assessment. However, as explained above, PG&E is not waiting for the completion of the regulatory process or review in other venues to act; it is acting now.

One key foundational component informing PG&E's initial Plan is that wildfire risks are differentiated across California. This Plan is intended to reflect that differentiation given the unique design and geography of PG&E's 70,000-square-mile service area, as well as the fact that more than half (52 percent) of PG&E's service area is identified as extreme (Tier 3) or elevated (Tier 2) fire-threat areas according to the CPUC's HFTD Map.¹¹ The wildfire safety strategies and programs described in this Plan are specifically intended to address PG&E's unique geographic service area.

PG&E's programs are designed to reduce ignition drivers and risk-event frequency associated with overhead electric facilities in high fire-threat areas, as indicated by the CPUC's HFTD Map. To develop the Plan, PG&E extensively analyzed wildfire risk factors to determine which factors have the highest incident rates and potential fire spread characteristics and potential alternatives to determine what additional operational actions, enhancements to existing programs, or other measures that will most effectively address those risks. To achieve the Plan objectives, PG&E will use a risk-based approach, meaning the highest risk areas will be addressed first, and will do more work than outlined in this Plan if it can do so without compromising safety or quality.

As directed by Administrative Law Judge Thomas in the *Administrative Law*

¹¹ The HFTD Map, adopted by the Commission in January 2018, designates three types of fire threat area: Tier 3 (extreme risk), Tier 2 (elevated risk), and a much smaller Zone 1 (made up of areas on the CAL FIRE/ United States Forest Service (USFS) High Hazard Zones (HHZ) map that are not subsumed within Tier 2 and Tier 3 HFTD areas). See Decision (D.) 17-12-024, p. 158, Ordering Paragraph (OP) 12, and Appendix D.

Judge's Ruling on Wildfire Mitigation Plan Template, and Adding Additional Parties as Respondents issued January 17, 2019 (ALJ Ruling), in this section PG&E is providing a summary of the objectives of its 2019 Plan. The ALJ Ruling also directed that objectives be broken down by time period: (1) before the upcoming wildfire season; (2) before the filing of the next WSP; and (3) within five years. For each objective, PG&E has indicated programs that will be completed with these time periods or, in certain cases, over a longer period. PG&E intends to continue to enhance these measures over time. The details regarding the timing of each objective are provided in Table 3 in Section 2.1, and further information about each program is provided in Section 4 of the Plan.

1. **Objective – Vegetation Management:** To address the potential for ignition from contact between PG&E facilities and vegetation through comprehensive vegetation management. PG&E will achieve critical milestones for this objective by the dates described below and will continue these efforts long-term (more than five years).
 - Enhanced Vegetation Management: Focusing vegetation management efforts on high-risk species of vegetation, vegetation with the most potential to come into contact with overhead electric facilities in the highest risk areas, and targeted fuel reductions (e.g., clearing of dry brush): approximately 1,000 circuit miles in HFTD areas by June 30, 2019, with approximately 2,450 circuit miles in total in HFTD areas by December 31, 2019.
2. **Objective – Enhanced Inspections and System Hardening:** To address the potential for ignition as a result of equipment failure through enhanced inspections and system hardening. PG&E plans to achieve critical milestones for this objective by the dates described below.
 - Enhanced and Accelerated Inspection and Repair Programs: Conduct accelerated and enhanced fire ignition-based inspections and repairs of overhead electric facilities in HFTD and adjacent areas. Inspections of all transmission structures, and substations in HFTD areas by May 1, 2019, and for distribution poles in HFTD areas by May 31, 2019. Anything identified as an imminent threat to public safety during an inspection will be addressed immediately.
 - System Hardening: Revising distribution design standards to increase overall strength and mitigate against impacts of external contacts (e.g., vegetation or wire on wire contacts) of approximately: 45 circuit miles by June 30, 2019; 150 circuit miles in total by December 31, 2019; and 7,100 circuit miles over a 10-year time horizon.

3. **Objective – Situational Awareness:** To obtain real-time knowledge of localized conditions that affect wildfire risk in order to operate the system to reduce risk of wildfires, including installing approximately: 200 weather stations and 30 cameras by June 30, 2019; 400 new weather stations in total by September 1, 2019; 71 new cameras in total by December 31, 2019; and 1,300 weather stations within five years. PG&E will grant fire agencies access to control the cameras, consistent with an approach taken by SDG&E.
4. **Objective – Operational Practices:** To perform electric system operations in a manner that reduces the possibility of wildfire ignition in times of elevated fire danger conditions and reduces fire spread including use of PSPS, enhanced operational practices, personnel work procedures, SIPT, and aviation resources. PG&E's goal is to achieve this objective by June 1, 2019, and the refinement of these activities will continue on an ongoing basis.
5. **Objective – Reducing Public Impact:** To reduce the impact on the public of wildfire safety measures. PG&E plans to achieve critical milestones for this objective by June 1, 2019, and will continue to enhance these measures through near-term (before filing the 2020 WSP) and long-term (more than five years) milestones.
 - Sectionalizing and Distribution Circuits: Upgrading devices with SCADA to minimize de-energization impacts and allow for increased targeting of the PSPS program: all existing line reclosers in Tiers 2 and 3 will be SCADA enabled by June 1, 2019 and additional sectionalizing taking place over the next 5+ years.
 - Resilience Zones: Configuring areas that can be isolated from the broader grid and energized by mobile generation during PSPS events: Complete pilot site before June 1, 2019 which will inform and dictate how the program should evolve in the future to better serve the needs of our customers; continue to research and add additional resilience zones as needed.
6. **Objective – Research:** PG&E, in partnership with experts and academics, is researching and evaluating a number of potential innovative technologies to address wildfire risk and will enhance its programs accordingly. Due to the inherent uncertainty of any new technology, the timing of implementation is unknown at this time. PG&E will implement new technologies as they become viable. PG&E will update the CPUC and parties on the progress of and results from this research in its annual WSP submissions.
7. **Objective – Wildfire Response:** To respond more quickly and effectively to major wildfires, regardless of the source of ignition (e.g., third party, lightning, etc.), and to prepare to rebuild and recover from a disaster safely, efficiently, effectively, and consistently. PG&E's plan is to be ready to meet this objective by June 1, 2019 by developing the wildfire response and post-incident recovery capabilities described in this Plan.

This Plan is designed to address the risk of wildfire ignitions associated with

electric facilities located in HFTD areas and to comply with the requirements of SB 901; and, where there are risks that cannot immediately be addressed, includes an expanded PSPS program to prevent wildfires. This Plan does not describe all ongoing operations and maintenance work that PG&E performs and will continue to perform that also help to reduce wildfire risk. Much of this ongoing work is performed in accordance with regulatory safety requirements, such as General Orders (GO) issued by the CPUC and California Public Resources Code (PRC) sections 4292 and 4293 for vegetation management.

This Plan does describe the additional work that PG&E proposes for 2019 to address wildfire risk. This additional work is focused on the high fire-risk areas designated by the CPUC's HFTD Map. As PG&E learns more, it will continue to improve and evolve these programs and may expand or re-prioritize the work described in this Plan. Table 2 below identifies the SB 901 requirements for wildfire mitigation plans, and the location in PG&E's Plan where each requirement is addressed.

TABLE 2: PLAN COMPLIANCE WITH CALIFORNIA PUBLIC UTILITIES CODE (PUC) § 8386(C)

Information Required by PUC § 8386(c)	Location(s) of Required Information in Plan
(1) An accounting of the responsibilities of persons responsible for executing the Plan.	Section 6.1
(2) The objectives of the Plan.	Section 1
(3) A description of the preventive strategies and programs to be adopted by PG&E to minimize the risk of its electrical lines and equipment causing catastrophic wildfires, including consideration of dynamic climate change risk.	Section 2.1, Section 4
(4) A description of the metrics PG&E plans to use to evaluate the Plan's performance and the assumptions that underlie the use of those metrics.	Section 6.2
(5) A discussion of how the application of previously identified metrics to previous plan performances has informed the Plan.	Section 6.3
(6) Protocols for disabling reclosers and deenergizing portions of the electrical distribution system that consider the associated impacts on public safety, as well as protocols related to mitigating the public safety impacts of those protocols, including impacts on critical first responders and on health and communication infrastructure.	Section 4.1.1, Section 4.6
(7) Appropriate and feasible procedures for notifying a customer who may be impacted by the deenergizing of electrical lines.	Section 4.6.3
(8) Plans for vegetation management.	Section 4.4
(9) Plans for inspections of PG&E's electrical infrastructure.	Section 4.2
(10) A list that identifies, describes, and prioritizes all wildfire risks, and drivers for those risks, throughout the electrical corporation's service territory, including all relevant wildfire risk and risk mitigation information that is part of Safety Model Assessment Proceeding (SMAP) and Risk Assessment Mitigation Phase filings.	Section 3.2
(11) A description of how the Plan accounts for the wildfire risk identified in PG&E's Risk Assessment Mitigation Phase filing.	Section 3.2.1
(12) A description of the actions PG&E will take to ensure its system will achieve the highest level of safety, reliability, and resiliency, and to ensure that its system is prepared for a major event, including hardening and modernizing its infrastructure with improved engineering, system design, standards, equipment, and facilities, such as undergrounding, insulation of distribution wires, and pole replacement.	Section 4.3
(13) A showing that PG&E has an adequate sized and trained workforce to promptly restore service after a major event, taking into account employees of other utilities pursuant to mutual aid agreements and employees of entities that have entered into contracts with PG&E.	Section 5.1.4
(14) Identification of any geographic area in PG&E's service territory that is a higher wildfire threat than is currently identified in a CPUC fire threat map, and where the CPUC should consider expanding the HFTD area based on new information or changes in the environment.	Section 3.4
(15) A methodology for identifying and presenting enterprise-wide safety risk and wildfire-related risk that is consistent with the methodology used by other electrical corporations.	Section 3.1

**TABLE 2: PLAN COMPLIANCE WITH CALIFORNIA PUBLIC UTILITIES CODE (PUC) § 8386(C)
(CONTINUED)**

Information Required by PUC § 8386(c)	Location(s) of Required Information in Plan
(16) A description of how the Plan is consistent with PG&E's disaster and emergency preparedness plan prepared pursuant to P.U. Code§ 768.6.	Section 5.1.1
(17) A statement of how PG&E will restore service after a wildfire.	Section 4.8, Section 5.1.2
(18) Protocols for compliance with requirements adopted by the CPUC regarding activities to support customers during and after a wildfire, outage reporting, support for low-income customers, billing adjustments, deposit waivers, extended payment plans, suspension of disconnection and nonpayment fees, repair processing and timing, access to utility representatives, and emergency communications.	Section 5.2
(19) A description of the processes and procedures PG&E will use to monitor and audit the implementation of the Plan, identify any deficiencies in the Plan, and monitor and audit the effectiveness of electrical line and equipment inspections.	Section 6.4

2. Program Overview and Climate Change Risk and Strategy

2.1. Overview of Strategies and Programs

Pursuant to PUC Section 8386(c)(3) and the ALJ Ruling, in this section, PG&E provides an overview of the strategies and programs in the Plan to reduce the risk of wildfires. Risk analysis and drivers are addressed in greater detail in Section 3 and PG&E's strategies and programs, as well as the targets, are described in Sections 4 through 6.

In response to the wildfires that occurred in 2017, PG&E initiated the Community Wildfire Safety Program (CWSP) to work closely with fire responders, customers, and communities, to implement new and enhanced safety measures to help reduce the risk of wildfires, as well as improve situational awareness and emergency response. The CWSP utilizes a risk-based approach to identify and address the assets most at risk of wildfire ignition and in areas with greatest potential fire spread. The comprehensive risk assessments performed as part of the CWSP, as well as geospatial modeling on both the volume and the location of fire incidents in PG&E's service area, have significantly informed the development of wildfire and safety programs.

Specifically, the CWSP includes a risk-based vegetation management approach for specific areas of PG&E's service area, such as trimming or removing high-risk tree

species, increased clearing of overhanging branches directly above and around power lines, and removal of vegetation fuels under and adjacent to power lines on a targeted basis.

Similarly, PG&E has transitioned to a risk-based facilities inspection approach for high fire-risk areas, including modified inspection methods and inspection frequencies. The CWSP also includes the use of new situational awareness technologies on the electric system such as high-definition cameras and weather stations.

PG&E's System Hardening Program has been broadened to include a rebuild of overhead distribution circuits in HFTD areas, including replacement of bare wire with insulated conductor, increased strength requirements for poles, installation of new system automation and protection equipment, and potentially targeted undergrounding, all of which will lessen the likelihood of ignitions.

Finally, PG&E has also adopted the PSPS program, or proactive de-energization of lines, using protocols that were based on benchmarking with SDG&E and in accordance with CPUC Resolution ESRB-8. Accordingly, a PSPS event will be implemented for lines that cross Tier 2 and Tier 3 HFTD areas when forecasts predict extreme fire-threat conditions. PG&E has developed and is continuing to improve the processes to identify the applicable conditions for PSPS and when to execute PSPS events, as well as to identify the appropriate channels to communicate possible impacts, in order to maximize wildfire safety while minimizing the disruption to customers and critical services. PG&E is also developing and evaluating ways to alleviate the risks and impacts of PSPS, such as through Resilience Zones. Resilience Zones will allow for important emergency and community services such as first responders, grocery stores, and gas stations to remain energized while the surrounding areas may be de-energized for safety. In addition, PG&E is investigating innovative customer service solutions to alleviate the impact of de-energization on our most vulnerable customers and communities, such as partnering with local OES to provide a safe, energized location for the vulnerable population during PSPS events.

The timeframe for all these strategies and programs can be found in Table 3 below.

TABLE 3: STRATEGY AND PROGRAM TIMEFRAMES¹²

Section	Title	Timeframe
4.1 Operational Practices		
4.1.1	Recloser Operations	Before the upcoming wildfire season
4.1.2	Personnel Work Procedures in Conditions of Elevated Fire Risk	N/A – Ongoing
4.1.3	Safety and Infrastructure Protection Teams	Before the upcoming wildfire season
4.1.4	Aviation Resources	Before the upcoming wildfire season
4.2 Wildfire Safety Inspection Programs		
4.2.1	WSIP, Distribution	Before the upcoming wildfire season
4.2.2	WSIP, Transmission	Before the upcoming wildfire season
4.2.3	WSIP, Substation	Before the upcoming wildfire season
4.3 System Hardening Overview		
4.3.1	Pole Material	Work is ongoing, HFTD completion Target is greater than 5 years
4.3.2	Pole Loading and Replacement	
4.3.3	Conductor	
4.3.4	System Protection	Within next 5 years
4.3.5	Equipment	More than 5 years
4.4 Enhanced Vegetation Management		
4.4.1	Vegetation Trimming and Overhanging Tree Limbs	More than 5 years
4.4.2	HFTD Vegetation Management (VM) Inspection Strategy	Before the next Plan filing
4.4.3	Inspecting Trees with a Potential Strike Path to Power Lines	Before the next Plan filing
4.4.4	At-risk Species Management	More than 5 years
4.4.5	Challenges Associated with Enhanced Vegetation Management	N/A Ongoing
4.4.6	Community and Environmental Impacts	N/A Ongoing
4.5 Enhanced Situational Awareness and Known Local Conditions		
4.5.1	Meteorological Operations and Advanced Situational Awareness	Before the next Plan filing
4.5.2	Fire Spread Modelling – Phase 1	Before the upcoming wildfire season
4.5.3	Weather Stations	Within the next 5 years
4.5.4	Camera Deployment Strategy	Within the next 5 years
4.5.5	Satellite Fire Detection Systems	Before the upcoming wildfire season

¹² Timeframe key: (1) before the upcoming wildfire season (estimated to be June 1, 2019 for purposes of this Plan); (2) before the next Plan filing (estimated to be February 2020); (3) within the next 5 years (2024); and (4) more than 5 years (beyond 2024).

TABLE 3: STRATEGY AND PROGRAM TIMEFRAMES¹³
(CONTINUED)

Section	Title	Timeframe
4.5.6	Storm Outage Prediction Model	Before the next Plan filing
4.5.7	Wildfire Safety Operations Center	In place, and will continue to implement new technologies before the next Plan filing
4.6 Public Safety Power Shut-off Program		
4.6.1	PSPS Decision Factors	In place, and will continue to evolve
4.6.2	Strategies to Enhance PSPS Efficiency While Reducing Associated Impacts	N/A
4.6.2.1	Impact Mitigation Through System Sectionalizing	In place, and will continue to identify methods to reduce PSPS impacts before the upcoming wildfire season
4.6.2.2	Resilience Zones	Pilot location operational before the upcoming wildfire season, and will continue to evolve and expand
4.6.2.3	Customer Services and Programs	In place, and will continue to evolve
4.6.3	PSPS Notification Strategies	In place, and will continue to evolve
4.6.3.1	Customer and Community Outreach	In place; PSPS customer outreach is ongoing and will continue before the upcoming wildfire season
4.6.3.2	Mitigating PSPS Impacts on First Responders, Healthcare Facilities, Telecommunication, and Water Utilities	In place, and will continue to identify methods to reduce PSPS impacts before the upcoming wildfire season
4.6.4	Re-energization Strategy	In place, and will continue to evolve
4.7 Alternative Technologies		
4.7.1	Rapid Earth Fault Current Limiter Pilot Project – Demonstration	Within the next 5 years
4.7.2	Enhanced Wires Down Detection Project – Phase 1	Before the next Plan filing
4.7.3	Other Alternative Technologies	N/A
4.8 Post Incident Recovery, Restoration, and Remediation Activities		
4.8.1	Post-Incident Recovery	N/A
4.8.2	Restoration	N/A
4.8.3	Remediation	N/A
4.8.3.1	Environmental Remediation – Debris Flow Modeling	Ongoing

¹³ Timeframe key: (1) before the upcoming wildfire season (estimated to be June 1, 2019 for purposes of this Plan); (2) before the next Plan filing (estimated to be February 2020); (3) within the next 5 years (2024); and (4) more than 5 years (beyond 2024).

2.2. Climate Change Risks

As required by PUC Section 8386(c)(3) and the ALJ Ruling, this section of PG&E's Plan describes climate change risks in California generally, and PG&E's service area specifically.

California has experienced dramatic environmental changes in recent years, resulting in record drought, unprecedented tree mortality, record rainfall, record heat waves, and extremely strong wind events. In recent years, the number and scope of wildfires in California has also increased substantially. In 2017, California experienced five of the 20 most destructive fires in its history up to that point in time. In November 2018, California experienced two more devastating fires—the Camp Fire in Northern California and the Woolsey Fire in Southern California. The Camp Fire is now considered the most destructive wildfire in California history, with over 80 fatalities and extensive property destruction.

A number of climate-related factors have contributed to the increasing risk of wildfires. For example, bark beetles and drought have contributed to record numbers of dead trees that fuel and amplify wildfires.¹⁴ Since 2010, according to the USFS, approximately 129 million trees have died in California. Moreover, as air temperatures rise, forests and land are drying out, increasing fire risks and creating weather conditions that readily facilitate the rapid expansion of fires.¹⁵

One of the key findings in the Climate Science Special Report, issued as a part of the Fourth National Climate Assessment in 2017, was that:

[T]he incidence of large forest fires in the western United States and Alaska has increased since the early 1980s [] and is projected to further increase in those regions as the climate warms, with profound changes to certain ecosystems.¹⁶

¹⁴ Assembly Floor Analyses, issued August 28, 2018, at p. 5, available at: http://leginfo.ca.gov/faces/billAnalysisClient.xhtml?bill_id=201720180SB901 (accessed October 2, 2018) (“Assembly Floor Analysis”) at p. 5.

¹⁵ The Atlantic, *Why the Wildfires of 2018 Have Been So Ferocious*, (August 10, 2018).

¹⁶ United States (U.S.) Global Change Research Program, *Climate Science Special Report: Droughts, Floods, and Wildfire*, Chapter 8 (2017).

More recently, the Fourth National Climate Assessment, which was issued in November 2018 as mandated by the United States (U.S.) Congress in the Global Change Research Act of 1990, concluded:

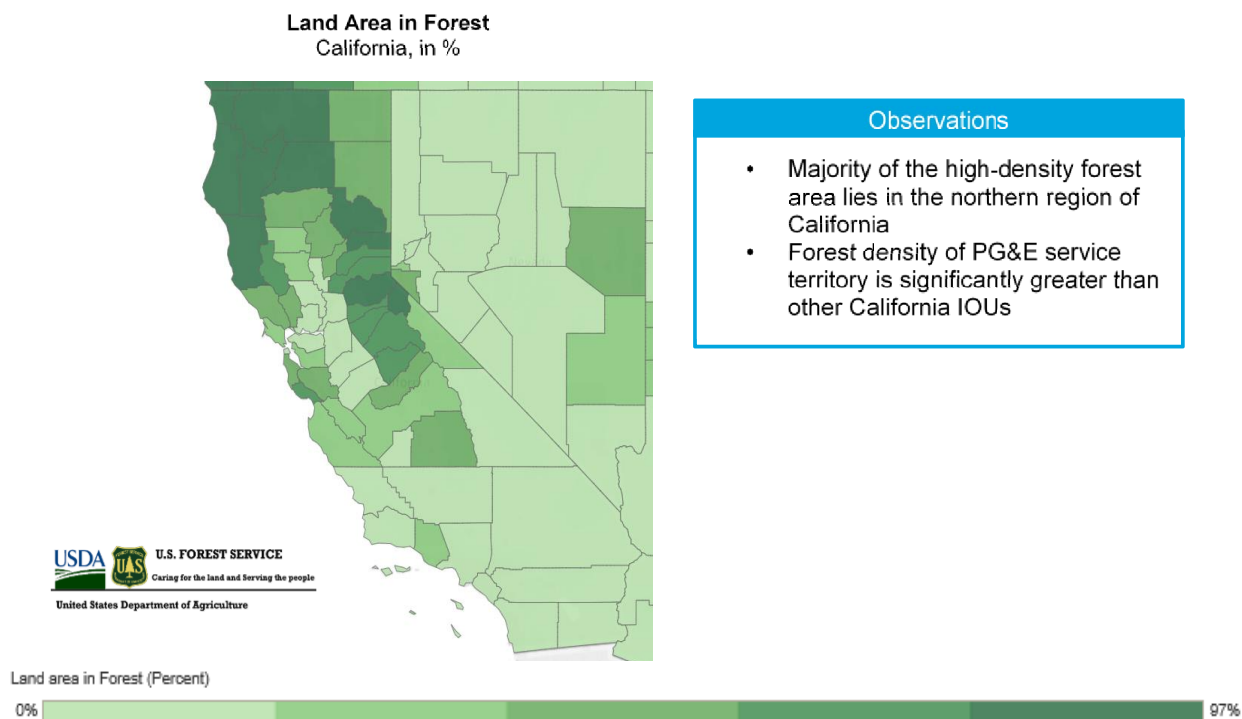
[W]ildfire trends in the western United States are influenced by rising temperatures and changing precipitation patterns, pest populations, and land management practices. As humans have moved closer to forestlands, increased fire suppression practices have reduced natural fires and led to denser vegetation, resulting in fires that are larger and more damaging when they do occur (Figures 1.5 and 1.2k) (Ch. 6: Forests, KM 1). Warmer winters have led to increased pest outbreaks and significant tree kills, with varying feedbacks on wildfire. Increased wildfire driven by climate change is projected to increase costs associated with health effects, loss of homes and other property, wildfire response, and fuel management.¹⁷

In short, California has not only entered a “new normal” with regard to the risk, magnitude, and devastating impact of wildfires, but as former Governor Jerry Brown explained, California has entered a “new abnormal” that will continue in the next 20 years.¹⁸ As a result of the new abnormal, wildfire season, when the risk of wildfire is much greater, may span eight months or more of the year.

Wildfire risks are not uniform throughout California. PG&E faces especially significant wildfire challenges due to the size and geography of its service area. PG&E’s service area is approximately 70,000 square miles and contains substantially more HFTD areas than exist in the service territories of the two other California Investor-Owned Utilities (IOU) combined. As shown in Figure 1 below, according to the USFS, the majority of high-density forest area in California is in Northern California:

¹⁷ U.S. Global Change Research Program, Fourth National Climate Assessment, Volume 2.

¹⁸ Los Angeles Times, *Gov. Brown: Mega-fires ‘the new abnormal’ for California*, (November 11, 2018).

FIGURE 1: HIGH DENSITY FOREST AREA IN NORTHERN CALIFORNIA¹⁹

Moreover, PG&E has more overhead distribution circuit miles in its service area that traverse HFTD areas than the other two IOUs combined. Approximately 65 percent of California IOUs' overhead distribution circuits located in Tier 2 and Tier 3 HFTD areas are in PG&E's service area. PG&E estimates there are more than 100 million trees adjacent to its overhead power lines with the potential to either grow into or fall into the lines. The strategies and programs described in detail above are specifically intended to address the unique wildfire risks associated with PG&E's service area.

3. Risk Analysis and Drivers

Pursuant to PUC Sections 8386(c)(10), (11), (14), and (15) and the ALJ Ruling, this section of PG&E's Plan addresses wildfire risks, and the drivers associated with these risks. Specifically, this section describes: (1) the methodology used by PG&E for identifying and evaluating wildfire risks; (2) a list of wildfire risks and drivers identified in the 2017 Risk Assessment and Mitigation Phase (RAMP) Report and more recently in PG&E's updated analysis; (3) how PG&E's Plan addresses wildfire risks; (4) an

¹⁹ Source: USDA Forest Service, 2017 RPA data.

evaluation of the CPUC's HFTD Map as required by PUC Section 8386(c)(14); (5) electric circuit prioritization based on wildfire risk; (6) PG&E Wildfire Evacuation Study; and (7) use of Probabilistic Assessments.

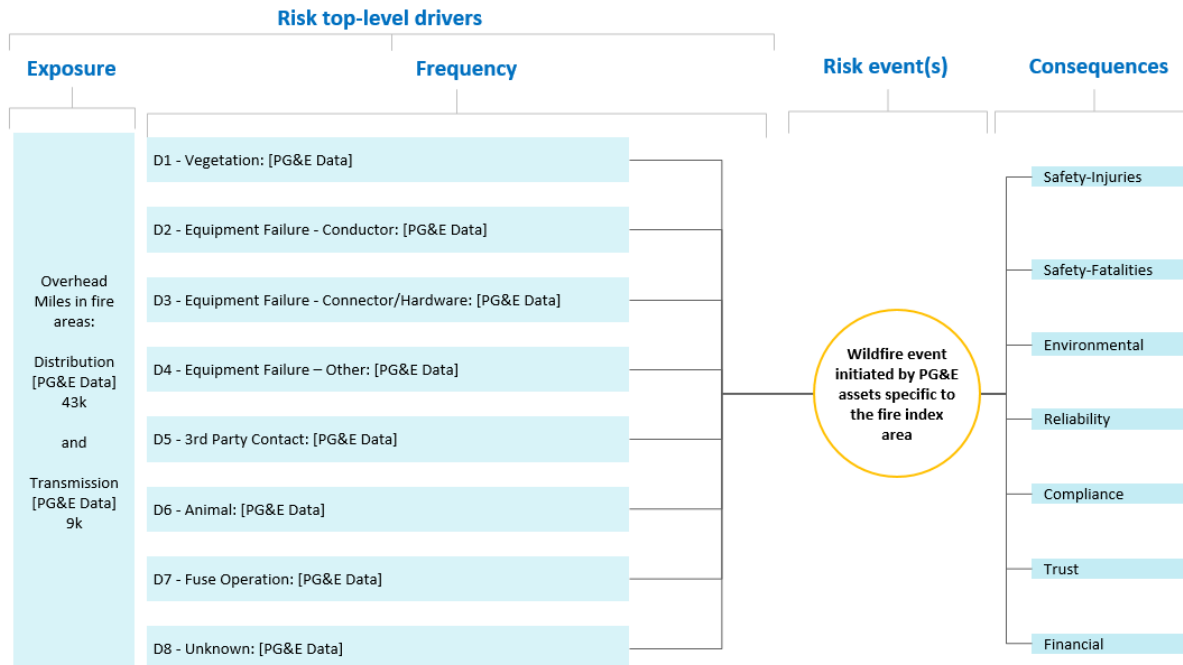
3.1. Methodology for Identifying and Evaluating Risk

In addition to presenting the risks and drivers analyzed in PG&E's 2017 RAMP Report, this section also discusses the risk identification and analysis that PG&E has performed since that 2017 filing.

PG&E's 2017 RAMP Report assessed wildfire risk using a common bow-tie risk methodology, where the risk event at the center of the bow-tie is a wildfire event initiated by PG&E assets specific to Fire Index Areas (FIA).²⁰ PG&E focused its wildfire risk assessment and effectiveness analysis based on this risk event and the specific drivers on the left side of the risk bowtie. This was the approach used in PG&E's 2017 RAMP Report, as shown below in Figure 2 below.²¹

²⁰ FIAs were originally developed by the USFS Pacific Southwest Forest and Range Experiment Station (now the Pacific Southwest Research Station) in 1959 and updated in the late 1960s and are still in use today by state (e.g., CAL FIRE) and federal agencies (e.g., USFS). These agencies refer to these areas as Fire Danger Ratings Areas (FDRA). For more information, see Attachment A: Fire Potential Index Methodology and Background.

²¹ See PG&E's 2017 RAMP Report, Chapter 11 – Wildfire, Section II for detailed description of risk bow-tie methodology and risk drivers.
<https://pgera.azurewebsites.net/Regulation/ValidateDocAccess?docID=431187#page=334>.

FIGURE 2: WILDFIRE BOW-TIE RISK

Since PG&E filed its 2017 RAMP Report, PG&E's analysis of wildfire risk has continued to evolve. PG&E's 2020 General Rate Case (GRC), filed with the CPUC in December 2018 in Application 18-12-009, describes the evolution and refinement of PG&E's wildfire risk analysis. For this Plan, PG&E has aligned the risk analyses from the 2017 RAMP Report and the 2020 GRC and developed an updated set of wildfire risks and drivers. By analyzing this updated set, PG&E seeks to more effectively address wildfire risk across the service area.²²

There are some significant refinements between the model used in the 2017 RAMP Report and the one used in the 2020 GRC. First, PG&E revised the number of overhead circuit miles considered to be exposed to wildfire risk based on new guidance from the Commission when it adopted the HFTD Map in January 2018. Second, PG&E updated its risk driver frequency assumptions based on this change in overhead circuit miles, as well as more recent fire incident data. Third, since filing the 2017 RAMP

²² In future WSP annual filings, PG&E's risk analysis may evolve to more specifically address the risk factors set forth in PUC Section 8386(c)(10)(A) (design, operations, construction and maintenance).

Report, PG&E has undertaken a more comprehensive evaluation of wildfire risk mitigation options, including a detailed assessment of the likelihood that specific mitigations could have reduced the potential risk of particular incidents identified in the fire incident database.

Following the 2017 and 2018 wildfires, PG&E used this updated analysis to help design and implement, via the CWSP, additional programs intended to address wildfire risks as well as improve situational awareness, mitigation, and response. CWSP wildfire programs target risk drivers associated with the highest incidence rates and potential fire spread.²³ Below, PG&E describes the evolution of wildfire risk and drivers analyses as identified in its 2017 RAMP Report and its most current analysis for identifying and evaluating wildfire-related risks through the CWSP.

3.2. List of Wildfire Risks and Drivers

3.2.1. Risks and Drivers Identified in RAMP

PG&E operates and maintains approximately 81,000 circuit miles of overhead distribution line and approximately 18,000 circuit miles of overhead transmission line across its service area. For the 2017 RAMP Report, PG&E measured its exposure to wildfire risk based on FIAs. Approximately 43,000 circuit miles of PG&E's overhead distribution line and 9,000 circuit miles of PG&E's overhead transmission line were within these FIAs for the 2017 analysis.

For additional details relating to risks and drivers identified in RAMP see Attachment D, Risks and Drivers Identified in RAMP.

3.2.2. Risks and Drivers Identified After RAMP

In its 2017 RAMP Report, PG&E committed to update its wildfire risk analysis and modeling and noted that it might propose additional precautionary measures intended to further reduce wildfire risk as more information became available.²⁴ To

²³ See 2017 RAMP Report, Chapter 11, Wildfire, Section III, Table 11-1.

²⁴ Comments of PG&E (U 39 M) on Safety and Enforcement Division's RAMP Report, May 10, 2018, Section III-A-2, p. 3.

perform a robust and inclusive wildfire risk assessment, and to consider additional practices to address wildfire risks and improve system resiliency, PG&E assembled an internal cross-functional team of experienced professionals, consulted with established risk assessment and management consultants, and benchmarked with other utilities in California, the United States, and Australia with experience in developing wildfire mitigation plans, as well as large-scale system rebuilds after disasters.

The team supplemented the 2017 RAMP Report risk analysis with consideration of two primary sets of additional data: First, the team analyzed ignition source data PG&E reported to the CPUC to determine mitigation program effectiveness at a more granular driver level than in the 2017 RAMP process. In accordance with D.14-02-015, PG&E reports annual fire incidents to the CPUC where: (1) ignition is associated with PG&E powerlines; (2) something other than PG&E facilities burned; and (3) the resulting fire traveled more than one meter from the ignition point. For the risk analysis discussed in this Plan, PG&E used the fire ignitions reported to the CPUC for years 2015 2017 (CPUC-Reportable Ignition Data). The team used this data to model the effects of different combinations and permutations of programs. In performing this analysis, the team assessed the potential reduction of historical ignition events that might have resulted had the proposed programs been in place at that time. In this evaluation, PG&E considered fire ignitions associated with distribution primary, distribution secondary, and transmission lines and equipment.

Second, the team updated the focus on the risk model based on the CPUC's HFTD Map. In January 2018, after submission of the 2017 RAMP Report, the CPUC adopted its HFTD Map.²⁵ The HFTD Map designates three areas where there is an increased risk from wildfires: Tier 3 (extreme fire risk); Tier 2 (elevated fire risk); and Zone 1 (USFS and CAL FIRE Tree Mortality High Hazard Zone Tier One not included in Tier 3 or Tier 2). The evolution of the HFTD Map is illustrated below in Figure 3.

²⁵ D.17-12-024, p. 158, OP 12, and Appendix D. See *also* CPUC Fire Safety Rulemaking Background available at: <http://www.cpuc.ca.gov/firethreatmaps/> (Fire Safety Rulemaking Background) (Accessed October 22, 2018) (describing the HFTD Map).

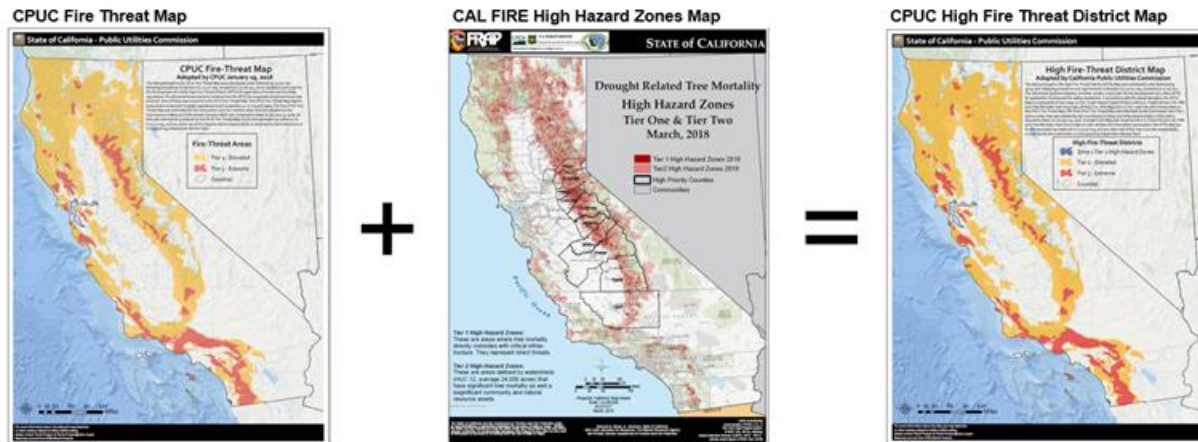
FIGURE 3: CPUC MAP EVOLUTION

Table 4 below summarizes the Tier 2, Tier 3, and Zone 1 areas included in the January 2018 HFTD Map:

TABLE 4: CPUC HFTD MAP TIER DEFINITIONS

Tier Level	Definition	Distinctions
HFTD Tier 3 – Extreme Risk	Extreme risk (including likelihood and potential impacts of occurrence) for utility associated wildfires.	Tier 3 is distinguished from Tier 2 by having highest likelihood of fire initiation and growth that would impact people or property from utility-associated fires, and where the most restrictive utility regulations are necessary to reduce utility-fire risk.
HFTD Tier 2 – Elevated Risk	Elevated risk (including likelihood and potential impacts of occurrence) for utility associated wildfires.	Tier 2 is distinguished from Zone 1 and other areas outside the HFTD by having greater likelihood of fire initiation and growth that would impact people or property, from utility-associated wildfires, and where enhanced utility regulation could be expected to reduce utility-fire risk.
HFTD Zone 1 – High Hazard Zones	HHZ on the USFS-CAL FIRE joint map of Tree Mortality HHZs, excluding areas in Tier 3 or Tier 2. These are areas where tree mortality directly coincides with critical infrastructure. They represent direct threats.	Zone 1 is defined as a Tree Mortality HHZ (as determined by California's Tree Mortality Task Force), a subset of Tier 1 of the CPUC HFTD Map. Zone 1 excludes areas in the Elevated Risk of Tier Level 2, and the Extreme Risk of Tier Level 3 risk areas but is included in the HFTD due to specific hazards to utilities. Tree mortality areas are identified by the USFS, CAL FIRE, and other State and Regulatory Agencies as determined by published district maps and are subject to updates.

Once the HFTD Map was approved by the CPUC, PG&E began using it to evaluate how to reduce wildfire risk, in place of the 2017 RAMP FIAs. The HFTD areas are different from, and smaller in size than, the combined FIAs used in the 2017 RAMP Report model. As shown in Tables 5 and 6 below, PG&E owns approximately 25,200 circuit miles of overhead distribution line and 5,563 circuit miles of overhead transmission line in the HFTD areas.²⁶ PG&E has updated the exposure data input to the wildfire risk model to the lower, more focused number of overhead circuit miles in the HFTD areas.

TABLE 5: APPROXIMATE DISTRIBUTION ASSETS

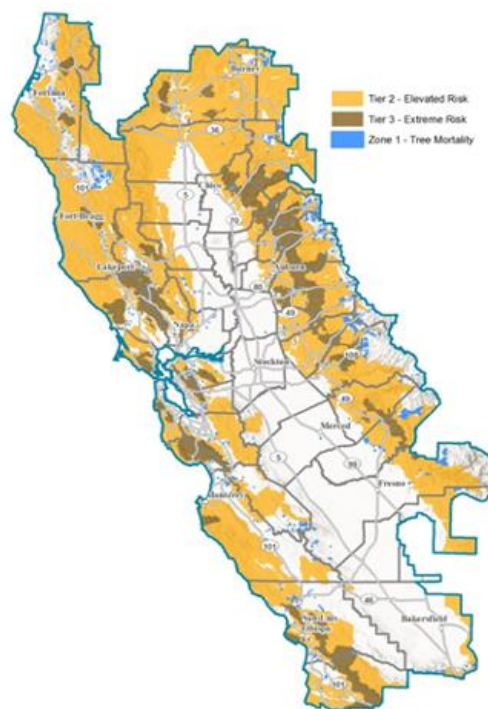
Distribution Overhead Assets	
HFTD Area	Line Miles*
Zone 1	100
Tier 2	18,000
Tier 3	7,100
Total	25,200

TABLE 6: APPROXIMATE TRANSMISSION ASSETS

Transmission Overhead Assets	
HFTD Area	Line Miles*
Zone 1	25
Tier 2	4,227
Tier 3	1,311
Total	5,563

* PG&E operates and maintains approximately 81,000 circuit miles of overhead distribution line and approximately 18,000 circuit miles of overhead transmission line.

Figure 4: PG&E Service Area Fire Threat Map



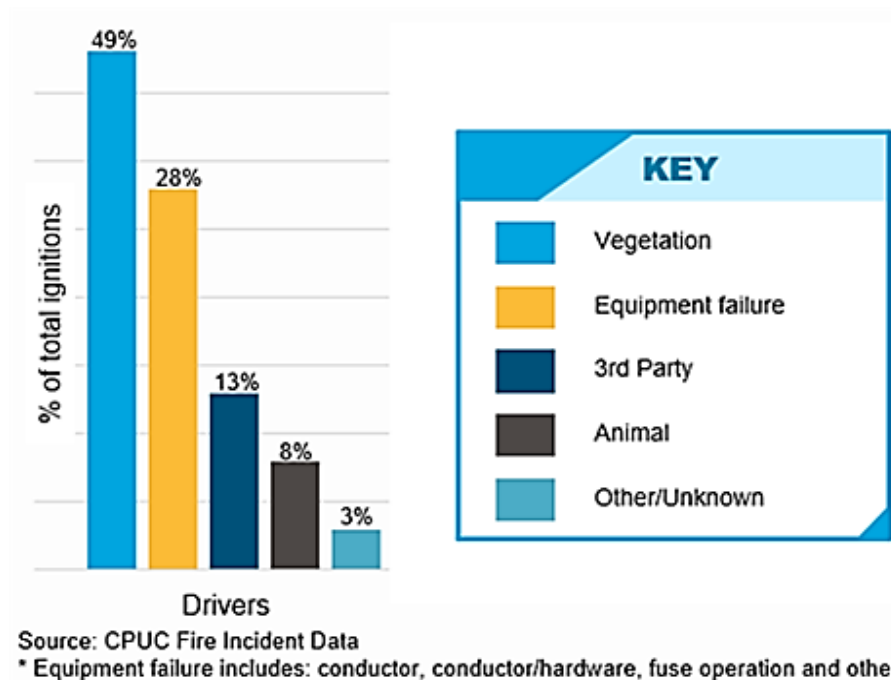
In addition, PG&E began using wind-related outage data from northeast wind events and CPUC-Reportable Ignition Data to further expand risk insights into the HFTD areas of highest concern. Driver frequency model inputs have been revised to utilize CPUC-Reportable Ignition Data, not all of which were available for use in the 2017

²⁶ The transmission line numbers exclude approximately 165 miles of transmission lines partially-owned, maintained, or operated by PG&E.

RAMP Report. The benefit of using this most recent dataset is to capture the “new abnormal” of wildfire risk that California is experiencing. The Risk Event Frequency for HFTD areas was determined to be 414 events over 2015-2017, with a driver frequency as follows (D = Driver):

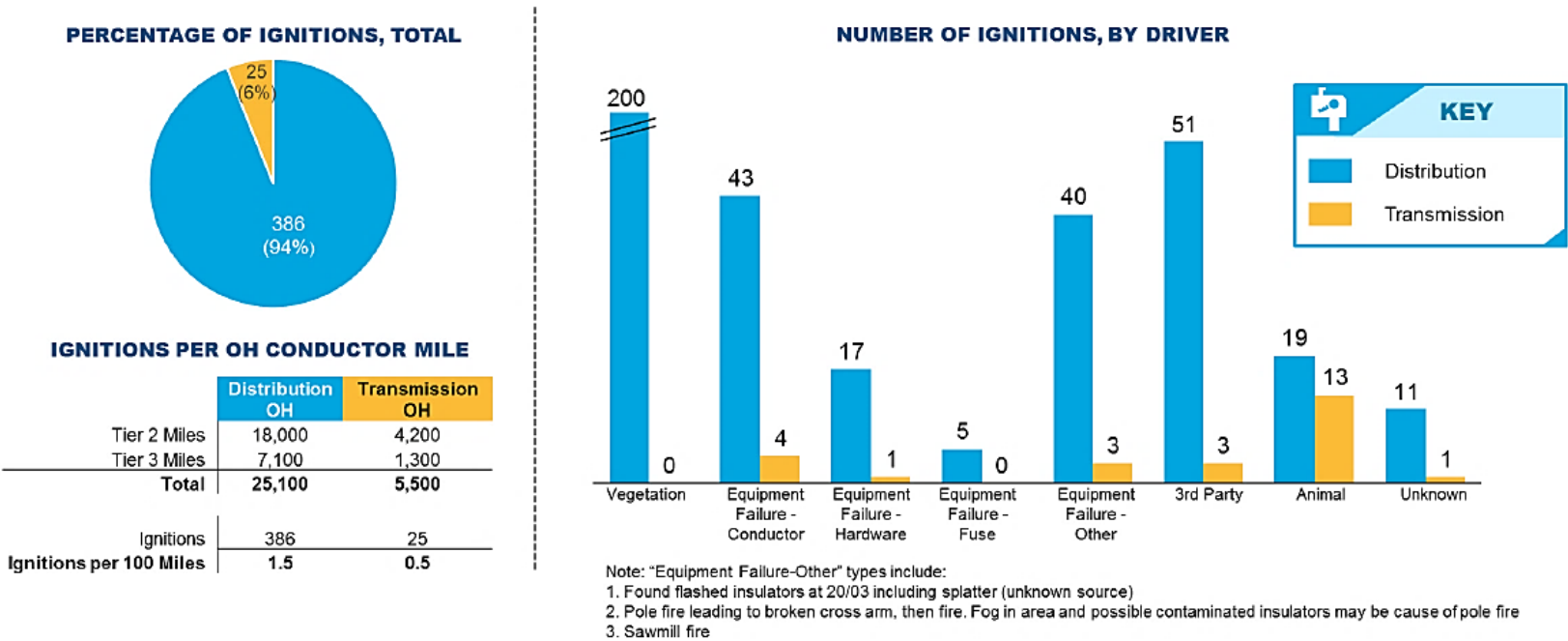
- **D1 – Vegetation (49%, 201 ignitions):** Tree, tree limb, or other vegetation contact with conductors that result in fire ignition.
- **D2 – Equipment Failure – Conductor (11%, 47 ignitions):** Failure of conductor resulting in wire down and fire ignition. All three equipment failure categories may be influenced by weather and other environmental factors (e.g., corrosive environment).
- **D3 – Equipment Failure – Connector/Hardware (5%, 19 ignitions):** Failure of connectors, splices, or other connecting hardware resulting in wire down and fire ignition.
- **D4 – Equipment Failure – Other (11%, 44 ignitions):** Failure of other line equipment, such as: poles, insulators, transformers, and capacitors, that leads to fire ignition.
- **D5 – Third-Party Contact (13%, 54 ignitions):** Contact caused by a third party, leading to fire ignition, such as cars hitting poles and Mylar balloon contacts.
- **D6 – Animal (8%, 32 ignitions):** Animal contacts that result in fire ignition, such as birds contacting energized conductors then falling to the ground and causing an ignition.
- **D7 – Fuse Operation (1%, 5 ignitions):** Operation of a fuse for a faulted condition that results in fire ignition from the blown fuse.
- **D8 – Unknown (3%, 12 ignitions):** Situations where PG&E was unable to determine the cause of the ignition; however, it appeared that the ignition may have been attributable to PG&E facilities.

Figure 5 below shows the relative percentages of 2015-2017 ignition drivers for HFTD areas of PG&E’s system.

FIGURE 5: 2015-2017 DRIVERS FOR FIRE INCIDENTS IN HFTD TIERS 2 AND 3, AND ZONE 1

As shown in Figure 6 below, based on historical data, distribution lines present significantly more risk than transmission, with ignitions per 100 miles nearly three times for the distribution system as compared to the transmission system. Further, while vegetation is the primary driver of ignitions for distribution lines, the primary risk driver for transmission lines-related ignitions are animal actions, with no vegetation-caused ignitions recorded for transmission based on the CPUC-Reportable Ignition Data.

FIGURE 6: IGNITIONS FOR TRANSMISSION AND DISTRIBUTION BY DRIVER



Key Takeaway: Ignitions per 100 miles are nearly 3x for the distribution system as compared to the transmission system

Source: CPUC Fire Incident Data, 2015 – 2017 (<http://www.cpuc.ca.gov/CPUCNewsDetail.aspx?id=6442454974>)

3.2.3. Risks and Drivers Associated With Design, Construction, Operations and Maintenance

Consistent with PUC Section 8386(c)(10)(A) and the ALJ Ruling, PG&E has identified which of the risks and drivers identified above are associated with five specific categories: (1) design and construction; (2) inspection and maintenance; (3) operational practices; (4) situational/conditional awareness; and (5) response and recovery. In future WSPs, PG&E may include more detailed analysis with risks and drivers associated with design, construction, operations and maintenance, as outlined in SB 901. Table 7 below provides summaries of the risk drivers broken down by the categories identified in SB 901 and the categories in the ALJ Ruling:

TABLE 7: RAMP RISK DRIVERS RELATED TO SB 901 AND ALJ RULING RISK CATEGORIES

	Cause	(1) Design and Construction	(2) Inspection and Maintenance	(3) Operational Practices	(4) Situational/ Conditional Awareness	(5) Response and Recovery
D1	Vegetation	X	X	X	X	N/A
D2	Equipment Failure – Conductor	X	X	X	X	N/A
D3	Equipment Failure – Connector/Hardware	X	X	X	X	N/A
D4	Equipment Failure – Other	X	X	X	X	N/A
D5	Third Party Contact	X				N/A
D6	Animal	X	X	X		N/A
D7	Fuse Operation	X	X	X	X	N/A
D8	Unknown					N/A

3.2.4. Topographic and Climatological Risks

PUC Section 8386(c)(10)(B) also requires consideration of topographic and climatological risk factors. Topography can be an important risk factor for fire danger in certain areas within PG&E's service area. For example, lee-side mountain slopes can be prone to strong downslope winds under certain weather conditions, which can cause increased risk of wires down and/or contact between uninsulated conductors in that area, leading to potential wildfire ignition. Winds can also be funneled through canyons

and mountain passes, resulting in similar effects. PG&E Meteorology's Fire Potential Index (FPI)²⁷ is applied to the 91 FIAs that cover the entire HFTD area. These areas are intended to capture sections of the service area with consistent fuel, topography, and exposure to meteorological conditions at a more granular level than the HFTD areas for more accurate weather forecasting.

In the 2017 and 2018 wildfire seasons, there was risk of wildfires occurring at almost any time. Historically, extreme fire danger has occurred in PG&E's service area from approximately June through November. Based on weather history, critically extreme fire danger is a rare occurrence—approximately one to two times per year in the most climatologically prone areas and less often in other areas. Based on historical weather patterns, these conditions have most frequently occurred in June and then again in September and October. However, a persistently dry fall and later start to the wet season may result in extreme fire risk extending later into the year. Generally, PG&E considers the following factors to determine when the wildfire season occurs: (1) when CAL FIRE initiates summer preparedness activities and winter preparedness activities; (2) when open burn policies are established at the county level; and (3) when there are more frequent occurrences of FPI days across PG&E's service territory.

The highest fire danger occurs under weather conditions with very low humidity and strong winds. However, temperatures, fuel loading, fuel type, and dead- and live-fuel moisture content are also important factors. PG&E's Meteorology team tracks and models fuel moisture content daily to determine the current state of the fuels as well as how the current season's values compare historically.

PG&E's service area is made up of a wide variety of different microclimates that have distinct seasonal weather characteristics, topography, and fuel types. Due to these differences, the PG&E Meteorology team studies historical fire occurrences by

²⁷ See Attachment A for an explanation of how the FPI is derived.

dividing the service area into nine different PG&E Fire Danger Climate Zones²⁸ to determine the significant thresholds of specific fire-danger variables to distinguish between fire danger conditions on a scale from Low to Extreme-Plus.²⁹ PG&E will continue to collaborate with the San Jose State University (SJSU) Fire Weather Research Laboratory, Atmospheric Data Solutions, and the other IOUs to increase understanding of fuel moisture monitoring and modeling.

PG&E's Meteorology team also completed a 30-year numerical reanalysis across its service area that will help to identify key weather patterns and characteristics that have led to extreme fire danger in the past in order to determine new thresholds for future fire danger modeling.

3.3. How PG&E's Plan Accounts for Wildfire Risks

PUC Section 8386(c)(11) directs utilities to provide a description of how their WSP accounts for risks identified in their RAMP filing. Because PG&E's wildfire risk analysis has continued to evolve since it filed its 2017 RAMP Report, the Plan addresses how PG&E accounts for wildfire risks identified in the RAMP filing as well as risks and drivers identified since that filing.

As discussed above in Section 3.2.2, PG&E utilized CPUC-Reportable Ignition Data to determine risk reduction effectiveness at a more granular driver level than previously performed in the 2017 RAMP process, by modeling different combinations and permutations of programs (in particular, different vegetation management practices and system hardening activities).

This methodology, in conjunction with benchmarking results,³⁰ informed the basis for the EVM and system hardening programs presented in the 2020 GRC and this

²⁸ PG&E Fire Danger Climate Zones overlay FIAs.

²⁹ See Attachment A: Fire Potential Index Methodology and Background.

³⁰ Utilities benchmarked against include: Arizona Public Services, Duke Energy (Indiana), Florida Power and Light, PEPCO (Maryland), Portland General Electric, Public Services of New Mexico, Puget Sound Energy, SDG&E, Southern California Edison Company, and Xcel Energy (Colorado).

Plan. Revised driver counts and assessments of risk reduction were then incorporated into the GRC risk model to quantify risk reduction, mitigation effectiveness rankings, and ultimately to assist in calculating the Risk Spend Efficiency values for the mitigations.

3.4. Evaluation of Higher Risk Threat Areas

PUC Section 8386(c)(14) directs utilities to identify any geographic areas in their respective service territories that are “a higher wildfire threat than is currently identified in the commission’s fire threat map, and where the commission should consider expanding the HFTD based on new information or changes in the environment.” Based upon its review of the HFTD Map and current information, PG&E believes the HFTD Map appropriately identifies areas within PG&E’s service territory requiring additional actions to reduce wildfire risk. PG&E will continue to evaluate the inclusion of additional areas requiring wildfire reduction activity in future plans based upon information obtained during the implementation and evaluation of PG&E’s Plan.

3.5. Circuit Prioritization Based on Asset Wildfire Risk

To maximize the efficacy of the wildfire risk reduction measures, PG&E’s Plan prioritizes circuits targeted for wildfire risk reduction measures using an asset risk-based approach. Under this approach, PG&E evaluates asset wildfire risk for individual circuits and then prioritizes implementation of wildfire risk reduction measures for circuits by their asset wildfire risk.

To enhance the understanding of asset-based wildfire risk, an initial assessment was completed to understand asset failure modes. This was completed by analyzing historical outages and corrective maintenance notifications to inform what asset conditions could lead to failure and related wildfire risk.³¹ Once these failure modes were established, PG&E assessed wildfire risk for individual circuits considering three components: (1) likelihood of asset failure; (2) risk of wildfire spread and consequence; and (3) egress risk.

³¹ Further details on PG&E’s Failure Modes and Effects Analysis (FMEA) process are provided in Section 4.2, below.

The likelihood of an asset failure was determined using a regression analysis to predict higher-than-average performance along a circuit. This analysis, completed at the structure level for transmission assets and at the circuit level for distribution assets, included an assessment of multiple variables including asset condition, asset location, asset characteristics (e.g., age, size, material, etc.), and historical work order data to assess the probability of higher than average expected failures.

To evaluate risk of wildfire spread and consequences, PG&E used the REAX Engineering, a third-party entity, wildfire spread and consequence model, similar to the methodology used to determine the HFTDs on the CPUC's HFTD Map. Wildfire spread considers fuel type, fuel density, topography, weather, wind, and distance from fire station or air suppression station. Wildfire consequence considers population density, structure density, and negative impacts to natural resources. This model developed a comparative risk score across PG&E's service area. Every PG&E structure lies within a certain percentile of spread and consequence based upon the model's analysis. Each percentile corresponds to a relative risk score within the model, correlating a comparative risk score to the electric transmission or distribution asset falling within that percentile.

Finally, an egress risk score was included in the model to understand the ease of entering and exiting a town or unincorporated community in the event of evacuation. This analysis was developed by looking at the number of road miles within a particular census-designated town or unincorporated community and comparing it to the population of that particular census-designated area. Since a road's ability to provide egress varies based upon the type of road, the number of road miles was weighted based upon the type of road (e.g., highways/interstates, country roads, residential roads).

For each circuit, these three scores (i.e., asset failure, wildfire spread and consequence, and egress) were multiplied together to develop an initial relative risk ranking. To prioritize circuits for implementation of specific wildfire risk reduction

measures, PG&E considers operational factors that could affect the implementation of those particular measures. For example, for measures involving circuit inspections, PG&E considered factors such as land and environmental, safety, already planned and scheduled projects, geographic access constraints, weather/wind, community, and customer considerations. These operational considerations were used to shift the timing of the enhanced and accelerated inspection, not to adjust the scope of the measures. Meetings were held with Subject Matter Experts (SMEs) in these program areas to consider relevant factors, and timing was adjusted accordingly.

This updated wildfire risk circuit prioritization presents a more robust approach to assessing potential wildfire risk across PG&E's assets, rather than focusing solely on the spread and consequence risk components. By including additional considerations, PG&E is better positioned to determine, understand, and further reduce wildfire risk using a risk-informed approach.

3.6. Wildfire Evacuation Study

PG&E is partnering with several renowned traffic simulation and evacuation experts to collaborate with a high fire risk community to perform a detailed wildfire evacuation study to examine anticipated traffic conditions and evacuation times associated with various rates of evacuation responses and alternative management strategies that could be used in response to them. The intent of this work is to develop a procedure or methodology that can be applied to any community with a high fire risk to improve their wildfire emergency plans and to inform PG&E's egress risk methodology with additional granularity.

The evacuation study report will document the demand estimation methodology (how many people and vehicles need to be evacuated), the highway capacity estimation, mobilization (trip generation) time distributions and the computed evacuation time estimates (ETE) in tabular and graphical format. The report will also contain a description of the traffic simulation and trip distribution and assignment algorithms utilized in the modeling system, the technical details of the study and the supporting

data. In addition, the report will identify traffic bottlenecks during evacuation and include a detailed discussion of potential improvements to evacuation time.

3.7. Use of Probabilistic Risk Assessments

PG&E is also partnering with the B. John Garrick Institute for the Risk Sciences, University of California Los Angeles (UCLA) to leverage the rigorous modeling used in the nuclear industry to perform thorough and complex wildfire risk assessments and management planning. PG&E has used a probabilistic risk assessment model for over 30 years at its Diablo Canyon Nuclear Power Plant. The model is constantly updated with current plant design and state of the art analysis methodologies. Data from 30 years of industry and plant specific experience is used to model component reliability and unavailability. The model is capable of performing quantitative assessment of risks from a multitude of complex factors, including internal plant failures, seismic events, fire and flooding. Each model element has been independently reviewed by industry peer review teams and the results have been audited on numerous occasions by the Nuclear Regulatory Commission. The model is capable of quantitatively risk ranking over 3,000 individual system components including the transmission lines that supply Diablo Canyon with offsite power. PG&E is planning to develop a similar model for wildfire risks for its electrical assets within HFTD areas.

4. Wildfire Reduction Strategy and Programs

This Plan describes the proactive and aggressive programs that PG&E is undertaking to prevent wildfires in 2019 and beyond. In some cases, these programs significantly expand and accelerate existing work, such as vegetation management and inspections. In other cases, these programs are entirely new, such as system hardening.

PG&E already performs a number of activities that address wildfire risk, across all of its assets in its service area, not just in HFTD areas, in accordance with regulatory and industry standards such as GOs 95 and 165 for the design, procurement, construction, testing, operations, and maintenance of its electrical assets, in particular,

overhead circuit conductors, structures, and equipment. The significant and aggressive expansion, enhancement, and acceleration of wildfire risk mitigation measures that are proposed in this Plan is in addition to PG&E's ongoing regulatory compliance workstreams.

PG&E created the CWSP, managed by PG&E's Wildfire Risk Management team, to support the implementation of large-scale and multi-year programs concerning wildfire risk. As discussed above in Section 3, the Wildfire Risk Management team has performed comprehensive risk assessments and geospatial modeling on both the volume and the location of CPUC-Reportable Fire Incidents from 2015-2017. This detailed analysis has led to the programs and strategies proposed in this Plan, which correlate to the ignition drivers as indicated in Table 8 below.

TABLE 8: CORRELATION OF PROGRAMS TO IGNITION DRIVERS

Section	Program	Vegetation (49%)	Equipment Failure (28%)	Third Party (13%)	Animal (8%)	Other/ Unknown (3%)
4.1	Operational Practices	X	X	X	X	
4.2	Wildfire Safety Inspection Programs		X	X	X	
4.3	System Hardening	X	X	X	X	X
4.4	Enhanced Vegetation Management	X				
4.5	Enhanced Situational Awareness and Known Local Conditions	Enabler to Operational Practices and PSPS Program				
4.6	PSPS Program	X	X			
4.7	Alternative Technologies	Enabler for System Hardening				
4.8	Post Incident Recovery, Restoration and Remediation Activities	N/A	N/A	N/A	N/A	N/A

Below, consistent with the outline adopted in the ALJ Ruling, PG&E provides a more detailed discussion of its:

- (1) Operational Practices (Section 4.1)
- (2) Wildfire Safety Inspection Programs (Section 4.2)
- (3) System Hardening (Section 4.3)
- (4) Vegetation Management Plan (Section 4.4)
- (5) Enhanced Situational Awareness and Known Local Conditions (Section 4.5)
- (6) PSPS Program (Section 4.6)
- (7) Alternative Technologies (Section 4.7)
- (8) Post Incident Recovery, Restoration and Remediation Activities (Section 4.8)

To provide a more thorough understanding of wildfire risks addressed by the Plan, PG&E has included descriptions of proposed Plan programs in these subsections, as well as routine operations and maintenance activities that also reduce wildfire risk. Under SB 901, proposed wildfire mitigation plans are intended to focus on actions minimizing the “risk of catastrophic wildfire posed by electrical lines and equipment.”³² PG&E’s routine operations and maintenance activities may reduce wildfire risks while serving other purposes, such as reliability. Therefore, while routine operations and maintenance activities are not a part of PG&E’s Plan, some are described below to provide a more complete picture of all actions PG&E is undertaking that will further reduce wildfire risk.

Table 9 below highlights the work PG&E is planning to complete in 2019; risk reduction measures proposed in this Plan as well as routine operations and maintenance activities. Table 9 also includes targets for 2019 associated with the Plan, the execution risk for each item, and whether the programs are covered in detail in PG&E’s Fire Prevention Plan (FPP) submitted in 2018. The items identified in Table 9

³² PUC Section 8386(a).

are discussed in greater detail in the identified sections. Timeframes for the Plan efforts can be found in Table 3, in Section 2.1.

TABLE 9: 2019 WILDFIRE SAFETY PLAN TARGETS³³

Section	Title	2019 Target	Execution Risk	Included in FPP
Operational Practices				
4.1.1	Recloser Operations	SCADA enable all remaining line reclosers (approximately 285) in Tier 2 and Tier 3 HFTD areas by June 1, 2019. Disable any remaining manual reclosing devices in advance of exposure to elevated wildfire risk conditions. Daily operations conformance with TD-1464B-001 and monitor program for effectiveness.	Qualified personnel or material limitations. Design, estimating or construction delays.	No
4.1.2	Personnel Work Procedures in Conditions of Elevated Fire Risk	Update guidance in TD-1464S and verify annual refresher training is completed for all field employees in advance of exposure to elevated wildfire risk conditions. Incorporate wildfire risk situational awareness into daily briefings.	Unforeseen emergencies can redirect field employees and delay necessary workforce training.	No
4.1.3	Safety and Infrastructure Protection Teams (SIPT)	Obtain and operate a minimum of 25 trucks + 3 trucks for extra coverage and the capability of type 6 wildland engines, staffed with 60 employees through an internal PG&E SIPT in partnership with International Brotherhood of Electrical Workers (IBEW). The SIPT will assist in WSOC ³⁴ decision making by acting as observers on high-fire risk days to inform PSPS decision making, protect PG&E assets, and assist with emergency response as approved and directed by the Agency Having Jurisdiction (AHJ) (e.g., CAL FIRE).	Getting stakeholder buy-in from external firefighter organizations in a timely manner so as to not impact PG&E's ability to hire and onboard employees in time for 2019 fire season.	No
4.1.4	Aviation Resources	Operate four heavy-lift helicopters to aid in fire suppression and restoration efforts by May 2019, available at CALFIRE's discretion.	Delays securing CALFIRE carding by May 2019. ³⁵	No

³³ Numbers in Table 9 are approximated for purposes of presentation in this table.

³⁴ More detailed information concerning the WSOC is provided in Section 4.5.7 below.

³⁵ Carding is the process of reviewing aircraft, support equipment and pilots each year to ensure they all meet the Cal Fire contract requirements. The Federal Government shut down delayed PG&E's request for a 133 Certificate that is required for the Cal Fire carding and contract.

**TABLE 9: 2019 WILDFIRE SAFETY PLAN TARGETS
(CONTINUED)**

Section	Title	2019 Target	Execution Risk	Included in FPP
Wildfire Safety Inspections Programs				
4.2.1	Wildfire Safety Inspection Program (WSIP), Distribution	<p>There are 685,000 poles located in the HFTD areas and adjacent areas with structures in close proximity and high risk of fire spread into the adjacent HFTD.</p> <p>1) Complete a WSIP enhanced inspection of all 685,000 poles in the HFTD areas by May 31, 2019.</p> <p>2) Complete high priority corrective actions created from deficiencies identified resulting from these enhanced inspections by June 30, 2019.</p>	<p>1) qualified workforce availability; and</p> <p>2) materials availability for repairs.</p> <p>Access limitations:</p> <p>1) inclement weather (snow, rain, wind, washed out roads, etc.);</p> <p>2) property owner objections; and</p> <p>3) Access rights (environmental permits, government owned land access permits).</p>	Current program scope not included
4.2.2	WSIP, Transmission	<p>There are approximately 50,000 poles and towers (structures) in the HFTD areas and adjacent areas with structures in close proximity and high risk of fire spread into the adjacent HFTD.</p> <p>1) Complete a WSIP enhanced inspection of all 50,000 structures by May 1, 2019. (Approx. 9,377 inspections were completed in December 2018.)</p> <p>2) Complete all high priority corrective actions identified during these inspections by May 31, 2019.</p>	<p>1) qualified workforce availability; and</p> <p>2) materials availability for repairs.</p> <p>Access limitations:</p> <p>1) inclement weather (snow, rain, wind, washed out roads, etc.);</p> <p>2) property owner objections; and</p> <p>3) Access rights (environmental permits, government owned land access permits).</p> <p>Scheduling Transmission segments out of service (customer impact and clearance process) may limit timeliness of repairs.</p>	Current program scope not included

**TABLE 9: 2019 WILDFIRE SAFETY PLAN TARGETS
(CONTINUED)**

Section	Title	2019 Target	Execution Risk	Included in FPP
4.2.3	WSIP, Substation	There are approximately 200 sites located in HFTD areas. These sites include substations, switching stations, and hydro power houses. 1) Complete-WSIP enhanced inspections for all sites located in HFTD areas by May 1, 2019. 2) Complete all high priority corrective actions created from deficiencies identified resulting from these enhanced inspections by May 31, 2019.	1) qualified workforce availability; and 2) materials availability for repairs. Access limitations due to inclement weather (snow, rain, wind, washed out roads, etc.) Scheduling equipment out of service (customer impact and clearance process) may limit timeliness of repairs.	Current program scope not included
4.3	System Hardening			
4.3.1	Pole Material	Complete 45 miles by June 30, 2019, and 150 miles in total by December 31, 2019, of overhead circuit rebuild or replacement in HFTD areas.	Securing necessary materials.	Current program scope not included
4.3.2	Pole Loading and Replacement		Securing adequate number of available trained personnel.	
4.3.3	Conductor			
4.3.4	System Protection	Continue to automate the remaining approximately 285 non-SCADA enabled reclosers in Tier 2 and 3 HFTD areas	Securing necessary materials. Securing adequate number of available trained personnel.	Current program scope not included
4.3.5	Equipment	Replace approximately 625 non-exempt fuses/cutouts in HFTD areas.	Securing necessary materials. Securing adequate number of available trained personnel.	Current program scope not included
4.4	Vegetation Management			
4.4.1	Vegetation Trimming and Overhanging Tree Limbs	Perform enhanced vegetation management work on approximately 1,000 circuit miles in HFTD areas by June 30, 2019, with approximately 2,450 circuit miles in total by December 31, 2019	Securing adequate available trained tree worker personnel. Working with IBEW and Mutual Assistance, PG&E brought on the maximum available resources in 2018. Variability of number of trees that need to be trimmed/removed per mile.	Current program scope not included

**TABLE 9: 2019 WILDFIRE SAFETY PLAN TARGETS
(CONTINUED)**

Section	Title	2019 Target	Execution Risk	Included in FPP
4.4.2	HFTD VM Inspection Strategy	1) Complete 100% of CEMA Patrols by the end of 2019. 2) Removing or working all dead or dying trees (“CEMA trees”) identified by October 1 of the current year, excluding trees affected have third party delays, including environmental permitting requirements, owner refusals, and agency approval or review.		Current program scope not included
4.4.3	Inspecting Trees with a Potential Strike Path to Power Lines	Assess more than 100 million trees with potential strike path on all CEMA Patrols.		Current program scope not included
4.4.4	At-risk Species Management	Perform enhanced vegetation management work on approximately 1,000 circuit miles in HFTD areas by June 30, 2019, with approximately 2,450 circuit miles in total by December 31, 2019.	Securing adequate available trained tree trimming personnel.	Current program scope not included
4.4.5	Challenges Associated with EVM		Number of trees that need to be trimmed/removed per mile given variability in find rate related to high risk tree species.	
4.4.6	Community and Environmental Impacts			
4.5	Situational Awareness			
4.5.1	Meteorological Operations and Advanced Situational Awareness	Deploy enhanced PG&E Operational Mesoscale Modeling System (POMMS) weather modeling system at 2 kilometers (km) resolution.		Yes
4.5.2	Fire Spread Model – Phase 1	Deploy operational fire spread modeling, driven by POMMS weather model, to allow improved understanding of catastrophic fire risk.		No
4.5.3	Weather Stations	Install 200 weather stations by June 30, 2019, and 400 weather stations in total by September 1, 2019 in HFTD areas.	Material delivery.	No
4.5.4	Camera Deployment Strategy	Operationalize and install 30 HD cameras by June 30, 2019, and 71 HD cameras in total by December 31, 2019, in HFTD Areas.	Installation and delivery of all items depends on single source vendor.	No

**TABLE 9: 2019 WILDFIRE SAFETY PLAN TARGETS
(CONTINUED)**

Section	Title	2019 Target	Execution Risk	Included in FPP
4.5.5	Satellite Fire Detection Systems	Develop, deploy and maintain an automated tool to detect and track new fires as they occur, issue alerts about new fires, as well as simulate the potential spread of new and existing fires.	Operational viability of new Geostationary Operational Environmental Satellite (GOES) West satellite.	Current program scope not included
4.5.6	Storm Outage Prediction Model (SOPP)	Automate analog storm matching and prediction functions in the SOPP model.		Current program scope not included
4.5.7	Wildfire Safety Operations Center (WSOC)	Increase situational awareness by integrating technology and processes intended to reduce wildfire risk into the WSOC to enable PG&E's collaboration with external and internal stakeholders and respond more effectively to wildfires.		No
4.6	Public Safety Power Shutoff Program			
4.6.1	PSPS Decision Factors	N/A – in place		
4.6.2	Strategies to Enhance PSPS Efficiency While Reducing Associated Impacts	N/A – see 4.6.2.1 through 4.6.2.3		
4.6.2.1	Impact Mitigation throughout System Sectionalizing	Identify and prioritize mitigation of PSPS impacts to customers where de-energizing the line will not result in a realized wildfire risk reduction.	Securing adequate number of available trained personnel.	No
4.6.2.2	Resilience Zones	Operationalize one resilience zone by June 1, 2019. Evaluate performance and effectiveness through post-event review. Incorporate learnings into future Resilience Zone establishment. Continue efforts to develop Resilience Zones in other towns in alignment with system hardening and targeted sectionalizing efforts.	Reliability of back-up generation equipment. Delays or trained personnel limitations associated with construction crew availability.	No
4.6.2.3	Customer Services and Programs	Continuously refine and further develop strategies that minimize the extent of disruption of grid power.		No

**TABLE 9: 2019 WILDFIRE SAFETY PLAN TARGETS
(CONTINUED)**

Section	Title	2019 Target	Execution Risk	Included in FPP
4.6.3	PSPS Notification Strategies	Attempt to send notifications (Integrated Voice Recording (IVR)), text and email) to all potentially impacted customers, and attempt to notify First Responders, Healthcare Facilities, Telecommunication Providers and Water Utilities in advance of residential notifications prior to a PSPS event. Attempt to provide additional notifications to life support/medical baseline customers prior to a PSPS event if general notifications (IVR, text, email) are unsuccessful.	Weather patterns, and timing of weather. Amount of time available to send advance notifications to customers. Size of impacted population.	No
4.6.3.1	Customer and Community Outreach	Refine customer notification tools and educate customer and communities to prepare for PSPS execution. Complete customer and stakeholder communications prior to potential PSPS initiation.	Changes in regulatory requirements or expectations as a result of R.18-12-005.	No
4.6.3.2	Mitigating PSPS Impacts on First Responders, Healthcare Facilities, Telecommunication, and Water Utilities	Proactively identify PSPS impacts to critical customers and services that support emergency response and preparedness. Ensure sufficient mapping, planning and communication protocols are developed prior to potential PSPS initiation.	Other related or non-related concurrent natural disasters in de-energized areas.	No
4.6.4	Re-energization Strategy	Re-energize only when confirmed safe to do so and only after protection zones are patrolled and clear of defects or damage. Prioritize as directed to maximize public safety and minimize outage impacts and duration.	Large scale events. Extensive facility damage during PSPS event. Trained and qualified workforce limitations. Access to difficult terrain. Aerial patrol limitations. Concurrent natural disasters in de-energized areas impacting workforce availability.	No

**TABLE 9: 2019 WILDFIRE SAFETY PLAN TARGETS
(CONTINUED)**

Section	Title	2019 Target	Execution Risk	Included in FPP
4.7	Alternative Technologies			
4.7.1	Rapid Earth Fault Current Limiter Pilot Project	Implement R&D Rapid Earth Fault Current Limiter pilot project.	Untried technology application within PG&E's system.	No
4.7.2	Enhanced Wires Down Detection Project	Complete Phase 1 of Enhanced Wires Down Detection Project	Untried technology application within PG&E's system.	No
4.8	Post Incident Recovery, Restoration, and Remediation Activities			
4.8.1	Post-Incident Recovery	N/A	Not Applicable	Yes
4.8.2	Restoration	N/A	Not Applicable	Partially
4.8.3	Remediation	N/A	Not Applicable	Partially

These programs, targets, and PG&E's efforts to plan for and manage these execution risks are discussed in further detail within the individual sections for each program below. The preventative strategies and programs included in this Plan are delineated into the categories identified in the ALJ Ruling³⁶ in Table 10 below:

TABLE 10: IDENTIFICATION OF ALJ RULING CATEGORIES

PG&E's 2019 Wildfire Safety Plan	ALJ Ruling Categories
4.1 Operational Practices	Operational Practices
4.2 Overview of Inspection Programs	Inspection and Maintenance
4.3 System Hardening Overview	Design and Construction
4.4 Enhanced Vegetation Management	Inspection and Maintenance
4.5 Enhanced Situational Awareness and Known Local Conditions	Situational/Conditional Awareness
4.6 Public Safety Power Shut-off Program	Operational Practices
4.7 Alternative Technologies	Design and Construction
4.8 Post Incident Recovery, Restoration and Remediation Activities	Response and Recovery

³⁶ See ALJ Ruling, Attachment A at p. 3.

4.1. Operational Practices

TABLE 11: OPERATIONAL PRACTICES KEY

Section	Title	Program Mapping	New³⁷ or Existing, Including Cost Recovery Vehicle	Regulation Compliance	Associated Drivers
4.1.1	Recloser Operations	Reclose Blocking	New - FRMMA ³⁸ & WPMA ³⁹	Exceeds regulatory requirements	D1 – D6, D8 ⁴⁰
4.1.2	Personnel Work Procedures in Conditions of Elevated Fire Risk		New – N/A	Exceeds regulatory requirements	Other
4.1.3	Safety and Infrastructure Protection Teams (SIPT)	Fire Fighting Resources	New – CEMA ⁴¹	Exceeds regulatory requirements	Not Applicable
4.1.4	Aviation Resources	Aviation Resources	New – Expense: CEMA; Capital FRMMA / WPMA	Exceeds regulatory requirements	Not Applicable

PG&E has developed a number of enhanced operational practices that are designed to further reduce the risk of wildfires during elevated fire danger conditions.

³⁷ For each of these charts in this Plan, “New” indicates the program costs have not been subject to Commission review and is followed by the applicable memorandum account.

³⁸ FRMMA represents the memorandum account required by SB 901, PUC Section 8386(j) to track costs of wildfire mitigation measures not otherwise included in revenue requirements, which PG&E submitted for CPUC approval on November 1, 2018. PG&E will track costs incurred before the Plan has been approved in the FRMMA.

³⁹ WPMA represents the memorandum account required by SB 901, PUC Section 8386(e) to track costs incurred to implement the approved Plan. PG&E shall submit the Electric Preliminary Statement for approval by Tier 1 Advice Letter. PG&E will track activity costs incurred pursuant to the approved Plan, but not included in PG&E’s approved revenue requirements, in the WPMA.

⁴⁰ D8 may vary depending on if the cause is known.

⁴¹ CEMA represents PG&E’s pending Application No. 18-03-015 for approval to increase rates related to the Catastrophic Event Memorandum Account, which includes forecast costs for drought-related work for 2019.

These enhancements relate to: (1) recloser operations; (2) work procedures in conditions of elevated fire risk; (3) PG&E's safety and infrastructure teams; and (4) aviation resources. Each of these Enhanced Operational Practices is explained in greater detail below.⁴²

4.1.1. Recloser Operations

PG&E Standard TD-1464B-001 establishes precautions for wildfire risks associated with recloser protection functions. Reclosing devices such as circuit breakers and reclosers are used to quickly and safely de-energize lines when a problem is detected and re-energize lines when the problem is cleared. Using analyses provided by fire officials and PG&E's Meteorology team regarding each year's fire season timeline and exposure, PG&E makes an informed decision on when to disable reclosers during elevated fire conditions in Tier 2 and Tier 3 HFTD areas. In some instances, this practice may reduce potential ignitions from sustained faults.

Following the 2017 wildfires, for the 2018 wildfire season, PG&E implemented the Wildfire Reclosing Disable program to disable automated reclosing during elevated wildfire conditions in Tier 2 and Tier 3 HFTD areas for distribution and transmission lines 115 kV and below.

⁴² As explained in detail in Section 4.5, PG&E utilizes state-of-the-art weather forecast model data and information from the National Weather Service (NWS), European Center for Medium Range Forecasting, and from PG&E's proprietary in-house mesoscale forecast model, POMMS, to generate short and medium-term fire danger forecasts across the service area, which inform PG&E's operational procedures.

As part of the reclosing disable process, a fire danger rating per FIA is determined on a daily basis during fire season by PG&E's Meteorology team using PG&E's wildfire danger rating system.⁴³ If the protection zone⁴⁴ of a reclosing device feeds an area with a fire index rating that is very high or extreme for a given day, the automated functionality of the reclosing device, which tests back into the line and potentially re-energizes the line if tested safe, is disabled. When the fire index rating is below very high, a threshold is selected, based upon historical-risk analysis, automated reclosing is enabled. For devices with SCADA, the reclosing functionality is adjusted daily as necessary based on the fire index rating for specific areas.

The Wildfire Reclosing Disable program includes nearly 2,800 reclosing devices on PG&E's distribution lines in Tier 2 and Tier 3 of the HFTD areas. At the end of 2018, approximately 2,100 of the distribution devices in the program were SCADA-enabled and capable of being disabled remotely. If a protection zone does not have SCADA capability in Tier 2 or Tier 3 HFTD areas, PG&E manually disables automated reclosing on these devices based on fire risk conditions as analyzed by PG&E's Meteorology team. These locations are identified and scheduled for disablement prior to the projected beginning of elevated wildfire risk exposure. These manual devices will remain disabled for reclosing until wildfire risk is significantly lower during the year.

PG&E is working to SCADA-enable all line reclosers in Tier 2 and Tier 3 HFTD areas by June 1, 2019. In addition, devices located on nearly 400 transmission lines with voltages of 115 kV and below were included in the 2018 program. Over 95 percent of the transmission line devices are SCADA-enabled and can be disabled remotely, and similar to the distribution devices that are not SCADA-enabled, PG&E will manually disable the remaining devices for the duration of wildfire season.

⁴³ See Section 4.5.1 below for additional information on how PG&E's Meteorology team derives fire danger ratings.

⁴⁴ A protection zone is the area or set of electric facilities for which a particular device can isolate electrical service.

Weather and field access challenges could impede the technical work required to SCADA-enable the line reclosers. Distribution line technicians cannot perform the testing and commissioning in the rain, and ground saturated with water impede the installation of new controllers and radio equipment. PG&E has tried to take these issues into consideration in developing the schedule, but unanticipated weather could delay PG&E's implementation timeline.

PG&E will continue to evaluate program effectiveness and build out of SCADA capabilities on the remaining distribution and transmission devices. These efforts will allow for effective and timely remote disabling and re-enabling of reclosing informed by fire danger.

4.1.2. Personnel Work Procedures in Conditions of Elevated Fire Risk

PG&E has established heightened procedures for field personnel to follow when working, traveling, or operating in hazardous fire areas. The procedures supplement instructions contained in fire regulation and use permits issued by the USFS, CAL FIRE, and other agencies that have jurisdictional authority. Procedures that apply during elevated fire risk conditions include:

- A requirement that each crew be equipped with well-maintained firefighting equipment;
- Additional restrictions on burning, welding, blasting, smoking and driving off cleared roads;
- A requirement to patrol lines prior to re-energization after a line trips due to a problem on the line; and
- A requirement to patrol lines prior to replacing blown fuses.

PG&E will train field employees annually on the heightened procedures and provide situational awareness in daily briefings.

4.1.3. Safety and Infrastructure Protection Teams

The Safety and Infrastructure Protection team or “SIPT” will be in place by June 1, 2019, to support PG&E’s work in high fire-risk areas. The SIPT will have experience and training in fire prevention and suppression, and emergency medical response. The purpose of the SIPT is to assist WSOC⁴⁵ decision making, protect PG&E assets, and assist with emergency response as approved and directed by the AHJ (e.g., CAL FIRE). During emergency situations, the SIPT will work in cooperation with the local fire AHJs and adhere to the Incident Command Structure (ICS).

If a fire starts at a PG&E work site, the SIPT’s first priority is to dial 911. Once first responders are on site, the SIPT will follow the ICS established by the responding agency. In 2018, PG&E contracted SIPT services. In 2019, PG&E will be establishing an internal SIPT organization consisting of a minimum of 25 trucks with the capability of type 6 wildland engines and crews, and 3 additional trucks for extra coverage and sick/vacation relief. The organization will be built in collaboration with the IBEW and external firefighter organizations. The primary execution risk in building the new internal SIPT organization is obtaining support from external stakeholders in a short time frame so as not to impact PG&E’s ability to hire and onboard employees for 2019 fire season.

During high fire-hazard conditions, the WSOC may request SIPT to:

- Stage resources in specific locations;
- Standby when PG&E field personnel engage in activities such as switching, hot work, or emergency repairs, as conditions dictate
- Deploy to confirm potential fire threats and provide data;
- Identify potential hazards in Extreme-Plus areas, as needed, during potential PSPS events; and

⁴⁵ More detailed information concerning the WSOC is provided in Section 4.5.7 below.

- Provide emergency response to fires, medical emergencies, basic life support, and secure the scene for the protection of PG&E's assets and/or workforce until the AHJ arrives.

Emergency work includes, but is not limited to, the following:

- Asset protection at PG&E facilities and other critical infrastructures;
- Vegetation Management support during wildfire recovery to suppress vegetation-related ignitions;
- Mop up of fire-damaged PG&E assets as permitted by the AHJ; and
- Accompany and support PG&E crews in fire restoration efforts during and after wildfires.

4.1.4. Aviation Resources

PG&E acquired four heavy-lift helicopters in 2018 to enhance wildfire safety and support utility infrastructure projects. The helicopters guarantee heavy-lift resource availability for PG&E facility restoration and construction support during fire season. The helicopters will be fitted with fire suppression equipment and available to aid in suppression efforts under the direction of the agency leading the response (e.g., CAL FIRE), if needed and requested.

4.2. Wildfire Safety Inspection Programs

TABLE 12: WILDFIRE SAFETY INSPECTION PROGRAMS KEY

Section	Title	Program Mapping	New or Existing, Including Cost Recovery Vehicle	Regulation Compliance	Associated Drivers
4.2.1	WSIP, Distribution	N/A	New - FRMMA/ WPMA	Exceeds regulatory requirements	D1, D2, D3, D4, D8 ⁴⁶
4.2.2	WSIP, Transmission	N/A	New - TO ⁴⁷	Exceeds regulatory requirements	D1, D2, D3, D4, D8
4.2.3	WSIP, Substation	N/A	New - FRMMA/ WPMA & TO	Exceeds regulatory requirements	D1, D3, D4, D8

PG&E routinely inspects its distribution, transmission, and substation assets using a variety of methods, including observations when performing work in the area, periodic patrols and inspections, and targeted condition-based and/or diagnostic testing and monitoring. These routine inspections of PG&E's overhead and underground electric systems, including its electric substation inspections, are designed in accordance with GOs 95, 165, and 174 requirements. Basic elements include travel to the asset, ground and air visual observation, detection and assessment of abnormal conditions, notification, prioritization and execution of repairs, and documentation needed for safe and reliable operation.

⁴⁶ D8 may vary depending on if the cause is known.

⁴⁷ TO represents PG&E's Federal Energy Regulatory Commission-jurisdictional Transmission Owner (TO) rate case.

In addition to these routine inspections, and as part of PG&E's risk-based wildfire safety efforts, PG&E is conducting accelerated inspections of overhead electric facilities in HFTD areas to facilitate a proactive approach to repairing or replacing components that are at-risk of initiating fires. These accelerated inspections and repairs constitute the Wildfire Safety Inspection Program or WSIP.⁴⁸

To develop the WSIP, PG&E used a risk-based approach including conducting a Failure Modes and Effects Analysis or "FMEA." The focus of the FMEA was to identify single points of failure of electric system components that could lead to fire ignition and then aid in the development of inspection methods that can most appropriately identify the condition of these respective components.

Each line of business performed the FMEA using the following methodology:

1. Establishing a cross-functional team of external professionals and PG&E SMEs with experience in field operations, engineering, and asset management.
2. Reviewing a list of asset components to identify potential single point failure ignition risks for categorization in an asset group.
3. Where available, developing an independent list of failure modes and frequencies from multiple internal and external sources using published reports, internal reports and SME interviews.
4. Mapping components to the final list of failure modes and relevant inspection methods.
5. In some cases, the failure mode does not have a readily observable issue that can be identified via a visual inspection. In those cases, non-destructive and destructive examination methods may be considered.

⁴⁸ The WSIP was developed and implemented after the 2020 GRC forecast was submitted to the CPUC.

The new and enhanced risk-based approach identifies WSIP work by assessing the risk associated with each asset and by explicitly considering equipment modes of failure. PG&E expects that these efforts will continue to evolve as information is gathered and more is learned. PG&E will use the results of the current inspections to continue to shape a risk informed re-inspection program and schedule for subsequent inspections.

After PG&E identifies areas for WSIP inspections, inspectors are sent out to perform inspections. When an inspector identifies a maintenance condition, the inspector either immediately corrects the condition and records the correction or records the uncorrected deficiency, which is reviewed by a centralized review team. The review team initiates a corrective notification or “tag” in SAP Work Management in order to initiate, assign, plan, execute, and close out repairs to facilities. These tags are assigned a priority based on the risk posed by the condition and urgency of repairs (i.e., Priority A, B, E, or F). The review team process is designed to result in consistent application of the priority classification.

Finally, Geographic Information System (GIS) data concerning the location of electrical facilities is important to many of PG&E’s wildfire risk reduction programs, including, but not limited to, inspection efforts and the WSIP, in order to understand the increased wildfire risk for each facility. Mapping and GIS data is also a critical component of PG&E’s PSPS program discussed in Section 4.6. PG&E and other IOUs are working collaboratively with state agencies including CAL FIRE, the California Office of Emergency Services (Cal OES), and the CPUC to align utility capabilities and agency data and mapping needs. Recognizing the importance of GIS, PG&E is working to improve its GIS data, including designating a single point of contact at PG&E for all wildfire-related GIS needs.

Significant barriers to WSIP implementation include the availability of a qualified workforce that will enable PG&E to perform the targeted volume of work in the desired timeframe as well as potential limitations on available materials necessary to perform corrective actions within necessary timeframes. PG&E faces market challenges in the implementation of the WSIP program with an intense demand for skilled labor and constraints on the availability of equipment and materials. PG&E recognizes these challenges and is aggressively leveraging its partnering and sourcing strategies to engage the qualified personnel, equipment, and materials necessary to enable the implementation of this plan.

In addition, implementation of the WSIP can be further delayed by weather conditions, delays caused by property owners and governmental agencies, and environmental permitting issues. PG&E's land management and customer care teams work closely with PG&E's inspection teams to overcome these challenges as quickly as possible. PG&E tries to reach out to landowners in advance to obtain consent, but it may still cause some delays. Access limitations due to property owners or permitting constraints are execution risks where the state or federal governments can play a role in supporting PG&E's wildfire prevention efforts.

In the subsections below, PG&E describes its WSIP inspections for different types of facilities (e.g., distribution lines, transmission lines, and substations). For comparison, PG&E also describes the routine inspections for these same facilities in Attachment C.

4.2.1. WSIP Distribution

As discussed above, in late 2018, PG&E conducted a FMEA to better understand any additional inspections and analysis that should be implemented to reduce wildfire risk in addition to the inspections required by GO 165. The FMEA identified failure mechanisms that could be inspected for and repaired as part of an accelerated inspection program focused on fire ignition risk.

In 2019, using this risk-based approach, PG&E is inspecting its distribution structures in HFTD areas, as well as nearby structures in close proximity and high risk of fire spread into the adjacent HFTD area (approximately 685,000 poles across approximately 25,200 miles). These inspections will focus on the failure mechanisms for transformers, conductors, connectors, insulators, fuses, switches, structures, third-party attachments, and splices that can initiate fires. To facilitate these inspections, PG&E will enhance its existing routine inspection program to include wildfire specific elements for 185,000 poles that are due for their five-year inspection cycle in 2019. Additionally, PG&E will conduct wildfire-specific inspections of the remaining 500,000 poles to identify and correct any components that pose a wildfire risk. Furthermore, PG&E will utilize drone inspections for difficult-to-access locations to identify abnormal asset conditions.

PG&E will complete all inspections of distribution poles in HFTD areas by May 31, 2019, and all high priority corrective actions identified by those inspections by June 30, 2019. The timing of any potential corrective actions will depend on the nature of the work; however, consistent with the corrective action prioritization process, PG&E will take immediate action to address any issues identified as an imminent risk to public or workforce safety.

This schedule could be impacted by availability of qualified linemen, access limitations, and outage scheduling limitations. PG&E recognizes these challenges and is aggressively leveraging its partnering and sourcing strategies to engage the qualified personnel necessary to enable the implementation of this plan. PG&E is also coordinating the work in advance to manage access and outage issues.

4.2.2. WSIP Transmission

In late 2018, PG&E conducted a FMEA of transmission assets to better understand any additional inspections and analysis that should be implemented to reduce wildfire risk in addition to the inspections required by GOs 95 and 165. The FMEA identified failure mechanisms that could be inspected as part of an accelerated

inspection program. Beginning in December 2018, and continuing into 2019, using this risk-based approach, PG&E is performing inspections of transmission structures (poles and towers) in HFTD areas, as well as nearby structures outside the HFTD in close proximity and with high risk of fire spread into adjacent HFTD areas (approximately 5,700 miles of transmission line with more than 50,000 structures). These enhanced inspections focus on the failure mechanisms identified from the FMEA based on PG&E and industry information that identified components with a fire ignition risk.

The visual inspections include ground inspection of transmission poles and climbing inspection of transmission towers. The scope of these inspections is beyond the routine detailed ground inspections of a population of the towers and poles.

Drone inspections will be conducted on every structure in the WSIP scope, subject to any FAA restrictions that cannot be resolved,⁴⁹ and will complement and further enhance the ground and climbing visual inspections. This new technology was fully developed and deployed in a one-month time frame and incorporated the results of the FMEA. Helicopters will be used for additional aerial inspections for collecting infrared data to determine hot spots on conductors, insulators, and connectors requiring repair.

⁴⁹ Drone flight is governed by the Federal Aviation Administration (FAA), Part 107 of the Federal Aviation Regulations (14 CFR Part 107). Among other things, these regulations establish operational restrictions on drone flights which may affect PG&E's ability to conduct drone inspections on every transmission structure in the WSIP scope. PG&E will work with the FAA to resolve operational restrictions to the extent possible.

These infra-red inspections will be performed at strategic times of the year when respective lines are highly loaded. PG&E is also investigating the application of a new helicopter-based inspection technology being employed in Australia. This autonomous image capture employs the use of helicopters and asset-based high definition camera programming to capture images via helicopter mounted cameras at pre-programmed locations. This allows an accurate and rapid capture of images over detailed ground and climbing inspections and drone technology, with equivalent image results as drones. Other elements of the enhanced program include the following:

- The FMEA modes were incorporated into newly developed electronic inspection forms;
- New and enhanced job aids were developed to support the inspection forms;
- The condition prioritization matrix used to assess the priority and timing of corrective actions was adjusted to factor in the results of the FMEA and job aids; and
- Prioritization of the notifications was transferred from the field lineman and supervisor to a multi-discipline review team to establish a focused review process of the potential findings related to the asset condition.

The previously described inspection plan was implemented beginning in December 2018, with nearly 20 percent of the inspections completed by year end. As of the end of January 2019 approximately 56 percent of the inspections have been completed.

In a typical year, PG&E performs as many as 76,000 routine detailed inspections of transmission system poles and towers throughout its service territory.

PG&E will complete all inspections of transmission poles and towers in HFTD areas by May 1, 2019, and high priority corrective actions identified by those inspections by May 31, 2019. The timing of any potential corrective actions will depend on the nature of the work; however, consistent with the corrective action prioritization process,

PG&E will take immediate action to address any issues identified as an imminent risk to public or employee safety.

This schedule could be affected by availability of qualified linemen, access limitations, and outage scheduling limitations. PG&E recognizes these challenges and is aggressively leveraging its partnering and sourcing strategies to engage the qualified personnel necessary to enable the implementation of this plan. PG&E is also coordinating the work in advance to manage access and outage issues.

4.2.3. WSIP Substation

In early 2019, PG&E began performing a FMEA of substation assets to better understand any additional inspections and analysis that should be implemented to reduce wildfire risk in addition to the inspections already performed in accordance with GO 174. The FMEA identified substation assets and their components and linked potential failure causes that could be inspected for as part of an accelerated inspection program. For 2019, using this risk-based approach, PG&E is inspecting approximately 200 sites located in HFTD areas, including substations, switching stations, and hydro power houses, with a specific focus on the failure mechanisms for transformers, conductors, connectors, insulators, switches, poles, and other equipment that can initiate fires. Additional risk focused work includes further evaluation of the risk of catastrophic equipment failure and fire initiation. Incremental efforts will focus on creating a defensible space around substation facilities consistent with CAL FIRE and CPUC recommended guidelines and evaluating and implementing animal abatement methods to prevent animal contact.

PG&E will complete all enhanced inspections of the approximately 200 sites in HFTD areas by May 1, 2019, and any high priority corrective actions identified by those inspections by May 31, 2019. The timing of any potential corrective actions will depend on the nature of the work; however, consistent with the corrective action prioritization process, PG&E will take immediate action to address any issues identified as an imminent risk to public or workforce safety.

This schedule could be affected by availability of qualified linemen, access limitations, and outage scheduling limitations. PG&E recognizes these challenges and is aggressively leveraging its partnering and sourcing strategies to engage the qualified personnel necessary to enable the implementation of this plan. PG&E is also coordinating the work in advance to manage access and outage issues.

4.3. System Hardening Overview

TABLE 13: SYSTEM HARDENING OVERVIEW KEY

Section	Title	Program Mapping	New or Existing, Including Recovery Vehicle	Regulation Compliance	Associated Drivers
4.3.2	Pole Material	Wildfire System Hardening	New - FRMMA/WPMA	Exceeds regulatory requirements	All
4.3.3	Pole Loading and Replacement				
4.3.4	Conductor				
4.3.5	System Protection	Automation and Protection (SCADA)	New – FRMMA/WPMA	Not Applicable	D3, D4 - Equipment failure
4.3.6	Equipment	Non-exempt Surge Arrester Replacement Program	New - FRMMA / WPMA & TO (Light Duty Steel Poles)	Exceeds regulatory requirements	

The System Hardening Program is an ongoing, long-term (more than five years) capital investment program to rebuild portions of PG&E's overhead electric distribution system. Under this program, PG&E is upgrading approximately 7,100 circuit miles in Tier 2 and Tier 3 HFTD areas. This program consists of ignition-risk-modeled and field-identified work that will result in a full rebuild of the overhead distribution system to increase its overall strength, replace aging assets, and reduce risk from external factors, such as vegetation contacting lines.

PG&E initiated the program in 2018, after the 2017 RAMP Report, in which PG&E proposed the targeted replacement of bare overhead conductor with covered conductor in high-risk wildfire areas.⁵⁰ As a result of supplemental risk assessment after the 2017 RAMP Report was submitted, the System Hardening Program has been broadened to include targeted pole replacement, replacement of non-exempt equipment, and potential targeted undergrounding. This work will occur based on PG&E's risk modelling of the distribution circuits.

The precise scope of hardening work will be site-specific and dependent on local conditions. Not every measure is effective or necessary at every location. As PG&E implements the system hardening program, we will continue to evaluate the design considering local conditions optimizing the appropriate solution for that location. For example, where appropriate, PG&E may perform some undergrounding of select overhead lines. In addition, bird/animal guards will also be installed where necessary to help prevent electrical contacts and outages. PG&E will continue to update the risk model with asset failure information, utility best practices, and new technology, which will result in a more refined asset investment plan.

PG&E is still in the process of refining its standards for the overhead hardening work, but currently expects that work will include the following components, depending on the specific locations (further details on some of the key components are provided in subsequent sections):

- Primary Conductor Replacement – replacement of bare overhead primary (high voltage) conductor and associated framing with conductor insulated with abrasion-resistant polyethylene coatings (sometimes referred to as covered conductor or tree wire). Installing covered conductor will help to further reduce the likelihood of faults due to line-to-tree contacts, tree-branch contacts, and faults caused by animals. Installing covered conductor will also prevent situations where bare wires

⁵⁰ PG&E 2017 RAMP Report, pp. 11-21.

slap together in high winds which can generate sparks of molten metal capable of igniting vegetation.

- Secondary Conductor Replacement – replacement of lower voltage (480V and below) conductor with insulated conductor. Installing covered conductor on secondary lines will have similar benefits to installing it on primary lines.
- Replacement of Non-Exempt Equipment – replacement of existing primary line equipment such as fuses/cutouts, and switches with equipment that has been certified by CAL FIRE as low fire risk and therefore exempt from vegetation clearance. This replacement work will eliminate overhead line equipment and devices that may generate exposed electrical arcs, sparks or hot material during their operation.
- Replacement of Overhead Distribution Line Transformers – upgrading transformers to FR3 Fluid as part of PG&E's current equipment standards (PG&E implemented the transition from mineral oil to FR3 in 2014). The newer transformers are filled with fire resistant FR3 insulating fluid, a natural ester derived from renewable vegetable oils—providing improved fire safety, transformer life, increased load capability, and environmental benefits. In addition, new transformers are manufactured to achieve higher Department of Energy electrical efficiency standards.
- Installation of Non-Wood Poles to Increase Pole Strength and Improve Fire Resistance – pole failures present safety hazards and may result in downed conductor faults, which may generate sparks. Furthermore, high-strength poles are needed to support the additional weight of insulated wire. PG&E is also evaluating various new non-wood poles that may provide increased fire resistance and pole strength.
- Upgrades to Electrical Protective Devices and Systems Through Equipment Replacements and Device Programming – this work also involves updating electric control equipment and wiring that may more

effectively identify downed conductor type outages and rapidly operate protective relays.

In 2018, PG&E initiated construction pilots to evaluate various overhead conductor and equipment configurations, including potential undergrounding, as well as to develop best practices. PG&E completed initial tree wire projects on approximately 17 circuit miles of distribution line in 2018. In 2019, PG&E will begin the System Hardening Program with a target of completing 150 circuit miles by the end of the year. In 2020-2022, PG&E forecasts completing work on 600 circuit miles per year during this period, and PG&E intends to complete work on 7,100 circuit miles.

PG&E expects completing the 7,100 circuit miles to take approximately 10 years due to the constraints on available qualified personnel and materials. The most significant potential barriers to completing the planned system hardening are limitations on the supply of necessary materials needed for the volume of work, particularly covered conductor, and the supply of adequately-trained personnel necessary to perform the work in the field. With regard to materials, and covered conductor, PG&E's Supply Chain department is working to satisfy a planned demand of reconductoring 150 circuit miles this year. The supply plan is in place with no anticipated delays or shortages of conductor. We are in the process of identifying external crews to fill the resource needs to construct 150 miles of wildfire hardening work for 2019. The construction of these projects is the highest priority, and the crews will be engaged as the projects are ready for construction.

In this section of its Plan, PG&E describes its system hardening strategies including: (1) pole material; (2) pole loading and replacement requirements; (3) conductors; (4) system protection; and (5) equipment.

4.3.1. Pole Material

The current PG&E distribution standard for overhead construction is open conductor and wood poles. This system is designed and constructed in accordance with GO 95, which suggests utilizing safety factors and clearances. The overhead system is engineered and built with electrical, structural, and mechanical considerations in mind. The poles are designed by PG&E experts utilizing an industry standard tool (O'Calc) to calculate structural integrity (vertical and transverse loading). The conductors are sized appropriately for the electrical loading as well as mechanical integrity in sag and tension. All variables utilized in PG&E's engineering analysis are consistent with or exceed those set by the CPUC.

In the recent years, California has experienced unprecedented wind and drought conditions that have led PG&E to consider installing structures for new construction or reconstruction in high wind areas that are more robust than required by design standards and parameters.

After the 2017 wildfires, PG&E further evaluated the type of materials used on its distribution system. Wood poles are natural products and inherently have some degree of variability. Poles are classified by their materials, which defines their minimum strength capability. However, as poles age, depending on their environment, they may not all react in the same manner. This lack of consistency in pole aging led PG&E to consider and start evaluating non-wood or engineered products to determine if they could have better performance consistency and/or increase fire resiliency.

PG&E initiated evaluation of various types of non-wood poles in 2018 and continues to work with other utilities and industry experts to determine the best product(s) for use in our overhead system. Materials that are being considered include composite, concrete, and steel. Factors being considered include strength capabilities, fire resiliency, ease of installation, and subsequent repairs/replacements as part of the asset lifecycle process. Initial findings indicate that for both strength and fire resiliency capabilities, a pole designed with a composite type material may have advantages over

a pole designed with materials such as steel, wood, or concrete. With respect to concrete poles, there are significant installation challenges, particularly in rural areas, due to their weight. Further, regarding steel poles, benchmarking with other utilities showed challenges related to the accompanying work.

Thus, PG&E is proposing to transition from wood to composite poles for distribution system hardening and fire reduction as the poles become available. These poles will be introduced for use to improve fire resistance and resiliency of poles in the high fire-threat areas. Although not fireproof, composite poles are fire resistant, flame-resistant and self-extinguishing once the heat source is removed. Testing by manufacturers indicates that composite poles retain both strength and integrity to temperatures of at least 1,200°F. Additional testing modeled after the CAL FIRE “fast moving brush fire test” produced limited surface charring and no structural damage. During this test, the poles withstood temperatures in excess of 2,000°F for 12 minutes without igniting. The added resiliency of non-wood poles should help to further reduce the possibility of downed conductor faults and the potential for fire ignition.

4.3.2. Pole Loading and Replacement

Under the Plan, PG&E is modifying pole loading model parameters and variables in light of historical data of various environmental factors (e.g., wind speed). Sizing for new and replacement distribution pole installations will consider historical peak wind speeds in areas where they exceed the GO 95-assumed wind speeds. In order to maximize the likelihood that poles are strong enough to withstand higher wind speeds, a pole loading calculation must be performed both at the loading conditions assumed by GO 95 conditions (load case) and at a summer peak wind load case (e.g., peak wind for location, 60-degree minimum temperature, no ice).

PG&E will adjust the required setting depth of a pole based on the current Allowable Overturn Moment table and comparing the values to the ultimate potential ground-line moment for a given pole design. This more stringent requirement supersedes previous PG&E requirements for minimum setting depth and will result in a greater amount of available pole strength (strength capacity divided by safety factor) at the equivalent soil overturn strength.

With regard to light duty transmission poles, as part of the System Hardening Program, PG&E will require the use of steel transmission poles in all new construction or refurbishment work except where it would cause an electrical hazard. Increased application of steel transmission poles will reduce the risk of pole failure during a wildfire event, resulting in shorter restoration delays. Installing steel for design purposes can also help increase the force the asset can withstand, which can help avoid wire downs from structure failures or external forces.

4.3.3. Conductor

The replacement of bare conductors with larger covered conductors (also known as tree wire) will further reduce the likelihood of faults due to trees, branches, animals, or birds contacting lines, and will further reduce situations where bare wires slap together in high winds, which can generate sparks or molten metal. The HFTD areas within PG&E's territory has a high volume of vegetation with large overhangs and ground fuels where the covered conductor is an effective risk mitigation. Thus, installation of covered conductors can be effective in providing fire reduction and reliability improvements from contact outages in heavily treed areas and further reduces the potential for failures related to smaller conductors. PG&E is replacing bare overhead distribution primary (high voltage) and secondary conductor with covered conductor in HFTD areas.

There is a limited risk that covered conductor may introduce higher impedance faults compared to bare conductor depending on how the conductor lands on the ground. However, an additional benefit of covered conductor is that it may be less likely to cause an ignition on the ground, as there is a lower potential for arc points along the line due to fewer contact points with the ground. Further, PG&E is currently piloting more sensitive protection for high impedance faults that may mitigate the additional high impedance risk.

The primary covered conductor coating PG&E is using is abrasion resistant crosslinked polyethylene. Crosslinked thermoset polyethylene covering is a new standard, which is an improvement over PG&E's prior standard, non-crosslinked thermoplastic polyethylene covering, because of its:

- Superior temperature resistance due to its higher softening point and cable used for a higher covering rating of 90°C versus 75°C;
- Increased chemical resistance at ambient and elevated temperatures; and
- Higher tensile strength, rigidity and hardness.

4.3.4. System Protection

There are approximately 2,800 reclosing devices on PG&E lines serving Tier 2 and Tier 3 HFTD areas. The devices that have reclosing functionality include substation circuit breakers, line reclosers, and TripSavers. PG&E's automation program will continue to automate these devices to enable selective reclosing functionality and support future protection schemes that may vary during high-risk fire periods. At the end of 2018, approximately 2,100 of the 2,800 reclosing devices serving Tier 2 and Tier 3 HFTD areas were SCADA-enabled. During 2019, PG&E will continue to automate the remaining non-SCADA line reclosers serving the Tier 2 and Tier 3 HFTD areas. In 2020, PG&E will automate the remaining non-SCADA TripSavers serving the Tier 2 and Tier 3 HFTD areas.

Existing distribution line reclosers that are operated for fire safety (e.g., as part of the PSPS or Recloser Disabling programs) were originally installed to optimize electric reliability and limit the number of customers exposed to outages, which can also present serious public safety concerns. These reclosers are often not optimally positioned to isolate the newly designated HFTD areas.

In an effort to further sectionalize distribution circuits and limit the duration as well as the number of customers impacted by PSPS events, PG&E is proposing to install additional line reclosers at Tier 2 and Tier 3 HFTD boundaries. In addition to the automation programs, PG&E is also evaluating different protection schemes and equipment that may further reduce the likelihood of a fire ignition when a system failure occurs. The program includes:

- Fusesavers™: Fusesavers™ enable localized isolation of all phases of a line when a problem is detected on only one or two phases. For example, if a single wire down on a three-phase line is detected, Fusesavers™ can automatically and locally de-energize all three phases. Installing these devices can also create additional points where lines can be segmented to support other wildfire risk reduction programs such as PSPS.
- High Impedance Fault Detection: PG&E is piloting and proposes to deploy newer protection capabilities of reclosers and circuit breakers that increase the ability to detect high impedance faults.
- Increased Protection Sensitivity: PG&E is evaluating the use of more sensitive protection settings and use of fast curves set on reclosers and circuit breakers. The proposed settings and use of fast curves would reduce the amount of energy experienced when a system failure occurs. This may lower the potential for a fire ignition to occur. The proposed protection schemes, however, could reduce the ability to coordinate with protective devices downstream and will lead to an increase in the size and duration of outages.

4.3.5. Equipment

PG&E proposes to eliminate non-exempt overhead line equipment in HFTD areas. Non-exempt equipment is equipment that may generate electrical arcs, sparks, or hot material during its normal operation. Due to these characteristics, PRC Section 4292 requires all utilities to maintain at least a 10-foot clearance of vegetation from the outer circumference of any pole that has non-exempt equipment. However, CAL FIRE tests and certifies some equipment as exempt from the vegetation clearance requirements of PRC Section 4292 where it is determined to be safer to use.

With increasing wildfire risks caused by changing climate conditions, PG&E has created a program to replace non-exempt fuses and cutouts to further reduce fire risk. The replacement of non-exempt equipment with exempt equipment will further reduce fire risk since this equipment is considered “non-expulsion” and does not generate arcs/sparks during normal operation.

Starting in 2019, PG&E forecasts replacing approximately 625 fuses/cutouts, and other non-exempt equipment identified on the pole each year for seven years in Tier 2 and Tier 3 HFTD areas.

4.4. Enhanced Vegetation Management

TABLE 14: ENHANCED VEGETATION MANAGEMENT KEY

Section	Title	Program Mapping	New or Existing, Including Recovery Vehicle	Regulation Compliance	Associated Drivers
4.4.1	Vegetation Trimming and Overhanging Tree Limbs	Enhanced Vegetation Management	New – FHPMA ⁵¹	Exceeds Regulatory Requirements, but generally supports PRC 4293 and GO 95, Rule 35	D1, D6, D8 ⁵²
4.4.2	HFTD VM Inspection Strategy	Enhanced Vegetation Management	New –FHPMA	Exceeds Regulatory Requirements, but generally supports PRC 4293 and GO 95, Rule 35	D1, D6, D8
4.4.3	Inspecting Trees with a Potential Strike Path to Power Lines				
4.4.4	At-risk Species Management				
4.4.5	Challenges Associated with EVM	Enhanced Vegetation Management	New –FHPMA	Exceeds Regulatory Requirements, but generally supports PRC 4293 and GO 95, Rule 35	N/A
4.4.6	Community and Environmental Impacts				

After the 2017 wildfires, PG&E aggressively expanded vegetation management around its assets. In addition, in January 2018, the CPUC adopted the HFTD Map, which drastically increased the amount of PG&E’s service area classified as “high fire-threat area.” Previously, the fire threat maps published in 2012 had included only a

⁵¹ FHPMA represents the Fire Hazard Prevention Memorandum Account established pursuant to decisions issued in R. 08-11-005, in which the CPUC authorized electric IOUs to record costs incurred to comply with D.17-12-024.

⁵² D8 is dependent upon if the cause is known.

small portion of PG&E's service area (about 15%) around Santa Barbara as "high fire-threat area."⁵³

Thus, after the 2018 wildfires, PG&E further expanded vegetation management around its assets. This work is critical because PG&E operates in a heavily forested⁵⁴ and vegetated area, particularly compared to the other large California IOUs. To address this risk, in 2018, PG&E began performing EVM work in HFTD areas. Much more aggressive than, and in addition to, ongoing VM programs, the EVM work includes the following activities:

- Overhang Clearing: removing overhanging branches and limbs directly above but outside the radial clearance zone around electric power lines required by regulatory requirements to further reduce the possibility of wildfire ignitions and/or downed wires due to vegetation-conductor contact.
- Targeted Tree Species Work: identifying and trimming or removing specific tree species within the fall or strike zone of power lines that have exhibited a higher pattern of failing; as well as addressing any dead or dying trees.
- Fuel Reduction: performing "ground to conductor" vegetative fuel reduction work to create fire defense zones under and adjacent to power lines in select locations to enhance defensible space for communities, properties, and buildings.

PG&E's baseline and long-standing VM programs are multi-pronged with various elements all designed to:

⁵³ See D.12-01-032 (January 18, 2012), at 262–63, available at: http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/157605.PDF (showing Reax Map for Northern California and FRAP Map for Santa Barbara County).

⁵⁴ For representations of the density of forests in PG&E's service territory within California. See pp. 3, 6, 7, 17 and more of https://www.fs.fed.us/pnw/pubs/pnw_gtr913.pdf.

- Proactively conduct tree work that reduces the likelihood of tree failure that could impact electric facilities and pose a public safety risk;
- Comply with State and Federal regulations regarding minimum vegetation clearance for the Electric Transmission & Distribution overhead systems;
- Perform annual inspections (and in HFTD areas, more-frequent-than-annual inspections) so that required vegetation clearances are maintained and hazardous trees are abated;
- Maintain vegetation-to-line clearances, and radial clearances around poles, pursuant to PRC Sections 4292 and 4293, GO 95 Rule 35 and FAC-003-4 (Federal Electric Transmission standard), this includes creating the recommended radial clearance of 12 feet or more at the time of trim for lines in HFTD areas for year-round compliance and risk reduction; and
- Validate that work was done as planned and intended through Quality Control (QC) and Quality Assurance (QA) reviews; including maintaining auditable records of all work done.

While these programs, generally focused on supporting compliance with minimum clearance requirements, are long-standing, they are not static or uninformed by the evolving wildfire risk. The 2019 distribution routine schedule (when each circuit will be inspected and subsequently worked) has been substantially re-aligned based on a relative risk ranking of all circuits to position the highest risk circuits to be worked before the peak of the traditional wildfire season.

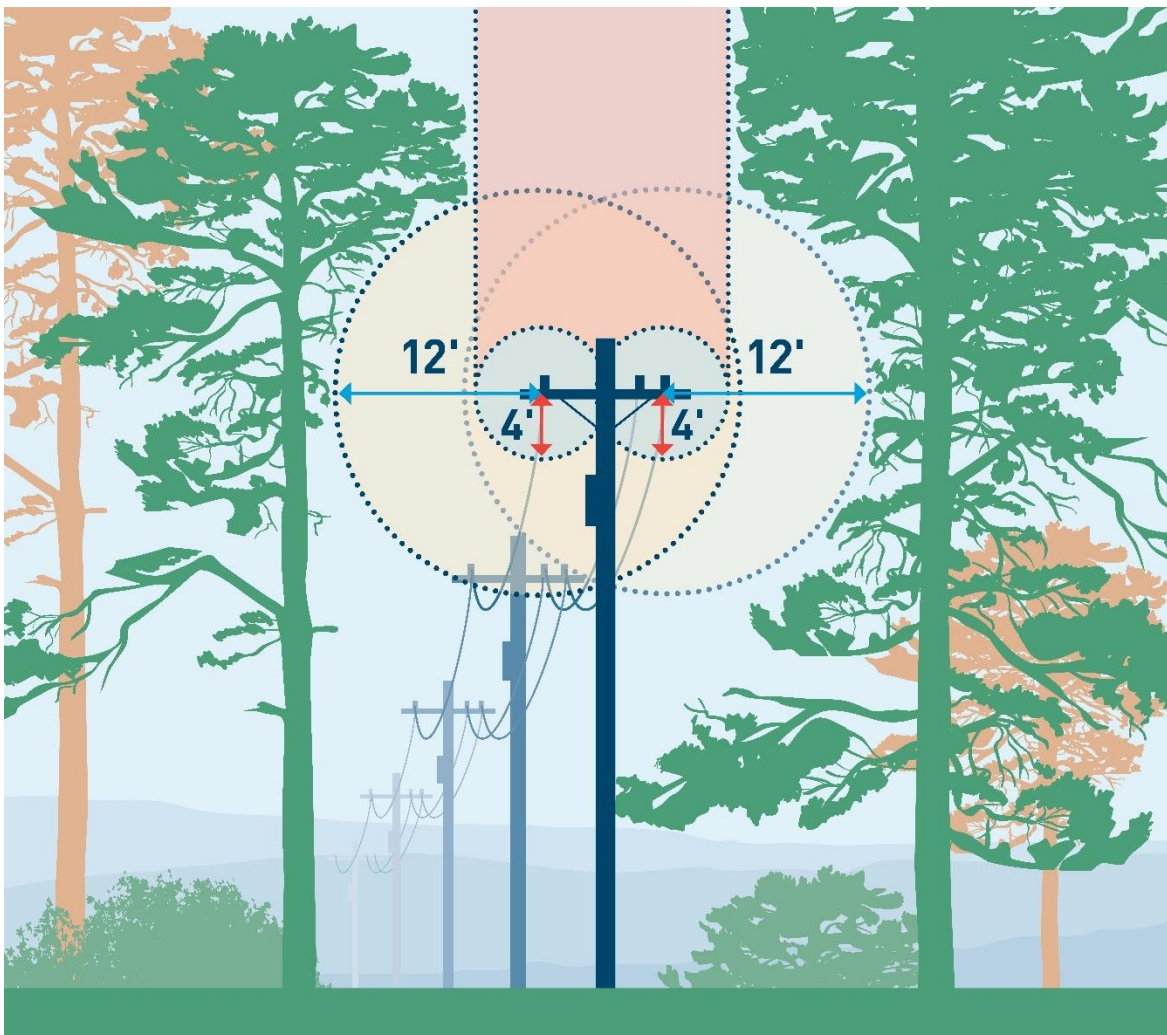
In the remainder of this Section, PG&E describes: (1) vegetation trimming and overhang work in HFTD areas; (2) its HFTD area inspection strategy, including inspection qualifications and QA; (3) inspecting trees with a potential strike path to power lines; (4) at-risk tree species management; (5) challenges associated with EVM;

and (6) minimizing community and environmental impacts of vegetation management work.

4.4.1. Vegetation Trimming and Overhanging Tree Limbs

In 2018, PG&E began performing expanded vegetation management work in HFTDs that included the clearing of overhanging vegetation from directly above and around distribution lines. This work is focused on further limiting the possibility of wildfire ignitions and/or downed wires due to vegetation-conductor contact.

For 2019 and beyond, the planned scope of this program is to remove all branches that directly overhang the radial clearance zone around electric distribution lines required by CPUC regulations and California statutes. GO 95, Rule 35 and PRC Section 4293 generally require a four-foot radial clearance between vegetation and electric distribution wires in HTFD areas. By removing overhanging tree limbs, there are fewer tree limbs that could fall or grow into the mandated clearance zones. See Figure 7 below for an illustration of the routine and EVM work.

FIGURE 7: ENHANCED VEGETATION MANAGEMENT

PG&E plans to clear about 2,450 circuit miles of overhangs in HFTD areas in 2019, with an increasing pace in future years. The scale, scope and complexity of this work necessitate that, to address the approximately 25,200 distribution circuit miles in HFTD areas, this program is established as a multi-year effort. As a comparison, over the last five years the maximum number of trees removed by PG&E's drought and tree mortality CEMA program was approximately 225,000 trees. As shown in Table 15 below, in 2019, the EVM program is anticipating trimming or removing approximately 305,000 trees while the CEMA program will still be in effect and is forecast to work approximately 70,000 trees. All of the work reflected in Table 15 is in addition to the more than one million trees PG&E's routine Vegetation Management programs have historically worked or removed annually.

TABLE 15: ANNUAL “ADDITIONAL” TREES WORKED

Trees Worked	2014	2015	2016	2017	2018 (est.)	2019 Forecast
CEMA	8,042	18,557	225,168	156,344	70,000	70,000
EVM + AWRR	–	–	–	–	90,000	305,000
Total	8,042	18,557	225,168	156,344	160,000	375,000

On the electric transmission system, all circuits are planned to be inspected and worked in 2019 to remove overhangs. This scope of overhang removal work will be incorporated into the annual inspection and tree work cycle for all transmission circuits. Due to the historically broader clearances maintained between transmission lines and vegetation and a practice of preventing direct overhangs of transmission lines, the number of trees anticipated to require work to align the electric transmission system with this scope will be significantly less than for the distribution system.

In addition to the initial overhang clearing work, discussed above, PG&E will need to perform annual, follow-up vegetation maintenance work on the sections of line cleared of overhangs, to keep all branches above powerline height from growing back into an overhanging position. As the number of miles initially cleared of overhangs increases, the annual maintenance and upkeep effort will also grow.

In 2018, PG&E also began a Fuel Reduction Program to reduce vegetative fuels under, and up to 15 feet on either side of, power lines located within HFTD areas. This work to create “fire defense zones” can:

- Create safe space between power lines and trees and brush that can act as fuel for wildfires;
- Help slow the spread of fires and improve access for first responders in the event of a wildfire; and
- Enhance defensible space around homes, businesses and properties, improving safety.

For 2019 and beyond, PG&E will work with property owners to perform this work in HFTD areas where property owners support the work and wildfire risk reduction

benefits can be created. The miles of line to be cleared through this effort will depend on various factors including vegetation density, topography, access and environmental considerations. In addition, until PG&E patrols lines, the number of trees that require trimming or removal is not known, impacting the rate at which lines can be cleared.

4.4.2. High Fire-Threat District VM Inspection Strategy

During PG&E's VM inspections, pre-inspectors identify vegetation that may grow too close to conductors or that may fail and contact conductors. PG&E's line clearance qualified tree work contractors then trim or remove trees as necessary to create adequate clearance and abate any hazard trees. More than 3,500 employees and contractors, including experts educated, trained, and certified in arboriculture and forestry, perform annual activities on behalf of PG&E's VM Department, involving approximately:

- 70,000 square miles of service area
- 81,000 miles of overhead distribution power lines
- 18,000 miles of overhead transmission power lines
- An estimated 100 million or more trees with the potential to grow or fall into overhead power lines
- Trimming or removing more than one million trees per year

In HFTD areas, inspections (e.g., drought and tree mortality inspections) are performed at least a second time each year and as often as four times per year in some locations (in Wildland Urban interface areas). From 2014-2017, over 400,000 dead and dying trees were abated by PG&E's drought and tree mortality program (i.e., CEMA), and PG&E removed approximately 70,000 more trees in 2018 and forecasts to remove an additional 70,000 trees in 2019.

Importantly, all trees identified for work by pre-inspectors are evaluated for the urgency of the required tree work. If tree failure is judged to be possibly imminent a

crew will be dispatched the same day. Trees can also be flagged for immediate follow-up work, while trees that require work but showing no near-term risk factors are scheduled following the standard process. The standard cycle time for trees exhibiting no near-term risk factors would be expected to be in the 60-90-day range after the completion of the pre-inspection activity. This means that some trees identified for work in one period (year, quarter, etc.) will not be worked until the next period. While these trees are sometimes referred to as “carryover” trees they do not represent a higher risk or a risk left un-addressed, they are simply trees where the normal work cycle resulted in them falling on the other side of a particular date. If any of these trees had been identified as immediate risk, they would have been addressed immediately.

Pre-inspection is the first step in the vegetation management process. Correctly assessing tree characteristics including species, health, growth rate, and likely failure patterns is critical to prescribing the appropriate vegetation management actions to reduce the wildfire risk from tree-line interactions. The pre-inspectors performing this work are qualified and trained, with many holding industry certifications. PG&E contracts with a limited number of well-established, large-scale vendors to perform this work. Throughout their training and once deployed pre-inspectors follow an established set of procedures for consistency in how the work is performed and findings/prescriptions recorded.

Beyond the training that the contractors provide to their pre-inspector staffs, PG&E also provides two full days per year of training to all pre-inspectors to align on safety practices, and relevant procedures. In addition, as explained below, PG&E’s VM QA effort is designed to validate that the entire process, starting with pre-inspectors, is creating the desired outcomes and identifies areas where expectations are not being met such that further action, including retraining or re-assigning staff, can be taken. PG&E’s vegetation management program incorporates changing environmental conditions, lessons learned, and new regulations. In the wake of the 2015 Butte Fire, PG&E adapted several practices to address risks identified in that incident. Among

other measures, PG&E initiated additional validation of contractor training programs for pre-inspectors.

For pre-inspectors to move up in their career path, they are required to acquire professional certifications from outside authorities. Specifically, the International Society of Arboriculture grants Certified Arborist and Utility Specialist certifications that directly support and validate proficiency in this kind of work. Maintaining these certifications also requires completing continuing education requirements. In addition, arborists can get certified as a Registered Professional Forester from the California State Board of Forestry and Fire Prevention. A pre-inspector cannot attain the 3rd or 4th step of the career progression without validating their proficiency through acquiring one (or more) of these certifications.

The final step in the vegetation management process is the QA Program to assess the quality work performed in the field. This is accomplished through the physical inspection of a sample of the PG&E system. The objective of the sampling exercise is to estimate the work quality rate for all trees in the geographic area covered by an audit. PG&E uses the results of the QA Program to improve future performance. PG&E has reviewed its QA Program and procedures with third-party experts who have validated that the sampling design in use is appropriate for PG&E's objectives, stating "The use of a cluster sampling design is entirely appropriate for PG&E's objectives...."⁵⁵

4.4.3. Inspecting Trees With a Potential Strike Path to Power Lines

Pursuant to PRC Section 4293 and GO 95, Rule 35, all PG&E vegetation management patrols inspect for hazard trees. A hazard tree is defined as a tree that has been assessed from the ground to pose a potential danger to fall or fail into electrical facilities due to all or a portion of the tree visibly exhibiting poor health or death, disease or decay, structural deficiency, or a compromised root structure. As part

⁵⁵ Dr. Karl Snow of Bates White Economic Consulting, PG&E's QA statistical sampling methodology.

of VM inspections PG&E pre-inspectors review all trees that are tall enough and have a feasible path to strike overhead lines. If the pre-inspector identifies a hazard tree that shows indications that it is at risk to fall into the power line it will be marked for treatment, including trimming or removal, and can be prioritized to be worked immediately or in the near-term if conditions warrant.

These physical, ground inspections are being augmented by the capture of LiDAR and related, remote sensing, data that can be thoroughly and consistently analyzed to take measurements, reveal patterns and identify risks in ways that an inspector on the ground cannot do precisely.

In 2018, PG&E captured LiDAR for most of Tier 3, and in 2019 and beyond, plans to capture and analyze data for all Tier 2 and Tier 3 HFTD areas annually. In fact, these annual data captures will, in addition to LiDAR, gather “hyperspectral” and imagery data that can, in combination with machine learning and powerful software solutions, allow for the potential identification of tree species and flag indications of trees that may be dead or dying.⁵⁶ Over time, the planned annual collection of this LiDAR, hyperspectral and other data will allow PG&E to assess (a) tree growth patterns; (b) the effectiveness of PG&E’s trimming or removal activities; and (c) change detection including third-party activities (like new tree plantings) that may impact powerlines. Overall, the expanded deployment of remote sensing data will support increasing knowledge of the risks facing our powerlines and support the further maturation of our risk management models and approaches.

4.4.4. At-Risk Species Management

PG&E’s VM team conducts site visits of vegetation-caused wires-down events as part of its standard tree-caused service interruption investigation process. The data obtained from site visits supports efforts to reduce future vegetation-caused wires-down

⁵⁶ To underscore the unprecedented scope of this work, PG&E’s 2019 data capture of approximately 25,200 distribution circuit miles is believed to be the world’s largest ever hyperspectral data survey.

events. The data collected from these investigations also helps identify failure patterns by tree species that are associated with wires-down events.

In reviewing five years of vegetation-related fire ignitions in Tier 2 and Tier 3 HFTD areas, including the wire-down data, PG&E identified that 10 species of trees⁵⁷ were responsible for nearly 75 percent of those incidents. Therefore, as part of the EVM Program, PG&E will focus on removing or trimming trees from these 10 species that are tall enough to strike distribution lines, have a clear path to strike, and exhibit other potential risk factors such as leaning toward a line or are weighting toward a line. This At-Risk Species Management work (also known as Targeted Tree Species Work) focuses on trees that are more than 4 feet from power lines (i.e., not within the scope of the overhang clearing program discussed in Section 4.4.1 above) and will include some taller trees located dozens of feet from power lines.⁵⁸ PG&E plans to begin this work in HFTD areas this year. PG&E's operational planning and forecast assume that this work will be performed in conjunction with the overhang clearing work outlined in Section 4.4.1, to maximize efficiencies and limit intrusion upon third-party property.

4.4.5. Challenges Associated With Enhanced Vegetation Management

Completing the expanded and accelerated EVM program faces substantial challenges that PG&E is proactively addressing in conjunction with several partners. The most significant challenge to the EVM program schedule is the limited availability of qualified work force. The most significant challenge to the EVM program schedule is the limited qualified tree workers, which limits the maximum pace of work. PG&E's experience casting a wide net and offering substantial financial incentives to hire additional tree personnel into its service territory in the fall of 2018 identified a maximum

⁵⁷ Black Oak, Gray Pine, Tanoak, Coast Live Oak, Live Oak, Ponderosa Pine, Eucalyptus/Blue Gum, Douglas Fir, Valley Oak and Monterey Pine.

⁵⁸ Note that this program primarily encompasses living trees. PG&E removes the majority of dead and dying trees that have the potential to contact its lines as part of our Drought and Tree Mortality Response Program.

volume of approximately 3,000 qualified tree workers that could be acquired to perform vegetation management activities. Identifying personnel that were qualified to safely perform this hazardous work was challenging.

The challenge of securing increased numbers of qualified personnel is further illustrated by PG&E's recent experience seeking assistance under the utility Mutual Assistance Agreement (MAA) following the Camp Fire. The first step in the Mutual Assistance process is to seek support from within California. However, limited personnel were available due to concurrent emergency response needs in the state. PG&E subsequently expanded its Mutual Assistance request to the Western Regional Mutual Assistance Group, followed by the Mid-West and Texas Regional Mutual Assistance Groups, and eventually all seven regional Mutual Assistance groups in the country. At each expansion of PG&E's request for Mutual Assistance, PG&E was unable to secure the requested number of personnel. PG&E's efforts to locate sufficient VM contractors after the Camp Fire was escalated to the status of a National Response Event, a process established for utility CEOs nationwide following Superstorm Sandy. In the end, the request for VM Mutual Assistance request was made to more than 200 utilities in an effort to locate 700 tree workers and 150 VM pre-inspectors to aid in recovery efforts. From that request, PG&E was only able to secure 223 tree workers and 40 pre-inspectors from across the country. And these workers only stayed for a limited period of time under the Mutual Assistance Agreements.

The limited pool of qualified personnel, whether through hiring or mutual aid, is exacerbated by the particular challenges of performing vegetation management work in Northern California. Not only is logging and tree felling one of the most hazardous industries in the nation, but the Northern California forests pose a very different challenge than most parts of the country. Safely removing a 200+ foot tall tree in proximity of a high voltage distribution line cannot just be performed by anyone with a chain saw. As an illustration, see the below image for the scope of a tree adjacent to powerlines that was removed during the 2018 EVM Program:

The pace of PG&E's multi-year EVM program is based on maintaining the maximum-available resource complement of approximately 3,000 qualified tree workers that could be acquired to perform vegetation management activities, as described

FIGURE 8: PG&E VEGETATION MANAGEMENT



above. Therefore, the pace of PG&E's multi-year EVM program is based on maintaining that maximum-available resource complement of approximately 3,000 tree workers. Leveraging that volume of workers, after accounting for the number needed to complete the annual routine vegetation management, results in an approximately 8-year EVM program from 2019 to approximately 2026. Any acceleration of that schedule would require identifying, with high confidence, a sustainable increase in the volume of trained, safe, qualified, line clearance certified tree workers. In order to address

this constraint, PG&E is exploring approaches to increase the population of qualified tree workers that could perform this work. For example, PG&E is partnering with our Tree Work Vendors and the IBEW to consider implementing a tree worker apprenticeship program that is intended to create a sustainable pipeline of new qualified personnel.

In exploring how to expand the available pool of qualified personnel to complete this critically important work, PG&E has also solicited help from various sources. On a nationwide level, the Bureau of Labor Statistics' most recent data on the entire "Tree

Trimmers and Pruners” occupation (from May 2017)⁵⁹ shows national employment of 41,140 (with 5,830 of those in California). However, only a small subset of these “Tree Trimmer and Pruners” possess the necessary skills and qualifications to work adjacent to powerlines (i.e., being “line clearance certified”).

To understand what level of workforce expansion might be possible to PG&E, in 2016 PG&E contracted with a vegetation management consultant to perform a market analysis of what might be possible in terms of bringing additional qualified personnel into California.⁶⁰ This consultant identified 46 total tree companies in the United States who were not already working for PG&E. Fifteen of those companies declined to participate in the analysis at all (most were small and regionally based) and 22 only participated in an initial survey stating that they had no interest in working in California due to (among other reasons): liability risk, regulatory/business environmental and insurance requirements, or lack of available qualified personnel to expand. The remaining nine vendors expressed, in aggregate, an ability to mobilize possibly a few hundred qualified personnel to California and generally expressed an interest in only emergency/short-term work, not a willingness to commit long-term to developing a workforce in California (or moving their existing workforce). In sum, while there are, of course, more tree trimmers and pruners throughout the United States, no successful solution has been identified for enticing utility-qualified workers to California for a long-term engagement, based on third-party and PG&E research and analysis.

Another potential challenge to timely completion of the planned vegetation management activities are the numerous legal challenges and requirements that must be navigated, including the need for land rights, local permit requirements, environmental requirements, and other state or federal requirements. These issues may involve concerned landowners and communities, local governments, state

⁵⁹ See Bureau of Labor Statistics website, *available at*: <https://www.bls.gov/oes/2017/may/oes373013.htm>, *last accessed* February 3, 2019.

⁶⁰ Resource and Market Assessment Report: Utility Line Clearance Contractors.

agencies, or federal agencies, and can cause significant delays in performing vegetation management work. PG&E may even be compelled to seek to obtain assistance from law enforcement or court orders to overcome some of these hurdles. For example, landowners objecting to tree work may prevent tree crews from entering their property: Locking gates, blocking access with vehicles and farm equipment, and occasionally to the extent of threatening them with firearms. Landowners may also threaten legal action, arguing that the extent of the planned tree work exceeds PG&E's land rights. In these cases, local law enforcement agencies will not assist PG&E in enforcing our recorded land rights unless and until PG&E obtains a court order.

As the clearances between conductors and vegetation increase, the vegetation work may also extend to properties adjacent to where PG&E historically trimmed vegetation. This could require PG&E to obtain land rights to those adjacent properties, causing further delay.

PG&E also must coordinate with numerous cities, counties, and other local authorities to obtain local encroachment permits or to manage other local requirements, such as heritage tree ordinances. Some state permitting requirements could cause further delay by triggering review under the California Environmental Quality Act (CEQA). For example, PRC Section 30000 imposes requirements on tree removal in coastal zones. Not only is this requirement administered by many local governments through certified local coastal programs, requiring coordination for each area worked, if a permit is needed, the level of CEQA review is determined separately by each permitting authority. Likewise, CAL FIRE forest practice rules also require approvals for the removal and disposal of trees. Vegetation management activities must also comply with endangered species and fish and game restrictions, which may trigger permitting requirements, as well as restrict when, where, or how the work may be performed (e.g., not during nesting season). Work on federal lands also require permits for tree removal, VM work, or land rights that predate federal ownership of the land.

PG&E's land and environmental management and customer care teams work closely with PG&E's vegetation management team to overcome these challenges as quickly as possible. They coordinate and plan the work in order to reach out to landowners, communities, and local governments to address concerns in advance of the proposed vegetation management activities. They also coordinate with local, state, and federal agencies to obtain necessary permits and conditions. PG&E tries to reach mutually agreeable results with concerned parties, but doing so regularly causes delays and sometimes PG&E must seek court orders. It could be helpful if the CPUC or state legislature addressed these constraints. For example, if the legislature extended PRC Section 4295.5 to also authorize utility tree workers to trim or remove trees or clarified the definition of a "conversion" in the forest practice rules to clearly exclude maintenance of a utility right of way, it could significantly improve the ability to execute vegetation management work. Likewise, legislative action could restrict the discretionary terms attached to encroachment permits.

4.4.6. Community and Environmental Impacts

Vegetation management work in general, and the EVM work in particular, has an impact on the communities and properties where work is identified. PG&E proactively communicates to and partners with land owners, government agencies and community organizations on the work we are planning along powerline corridors. As discussed above in Section 4.4.5, communications may result in delays to address concerns or permit requirements. But through this communication, opportunities also arise for communities or agencies to leverage the work PG&E is doing to support or enhance community specific plans or efforts. In addition, for the past several years PG&E has provided grant funding to community organizations (generally Fire Safe Councils) to support them in performing community wildfire risk mitigation efforts, like fuel break creation or fuel cleanup efforts, that may not be adjacent to PG&E powerlines and therefore outside of the scope of PG&E's vegetation management programs.

The performance of vegetation management work could create environmental impacts, which PG&E is careful to monitor and manage. For example, PG&E VM contractors are trained on Best Management Practices and Avoidance and Minimization Measures to manage erosion, prevent impacts to sensitive environmental resources (e.g., bird nests, sensitive species and habitats) and protect waterways. Similarly, changing the ecosystem of a stand of trees can create new risks, like exposing a previously protected tree to increased sunlight or wind, that the utility arborists performing PG&E's vegetation management work are conscious of and on the lookout for. Trees that exhibit risk factors (like poor taper) that could be a risk after adjacent tree work is performed may be proactively identified for treatment (trimming or removal). Finally, as described above, all HFTD portions of PG&E's powerline corridors are re-inspected at least twice per year, allowing for the ongoing monitoring of any changes or growth patterns that may have been influenced by previous tree work.

4.5. Enhanced Situational Awareness and Known Local Conditions

TABLE 16: ENHANCED SITUATIONAL AWARENESS AND KNOWN LOCAL CONDITIONS KEY

Section	Section	Program Mapping	New or Existing, Including and Recovery Vehicle	Regulation Compliance	Associated Drivers
4.5.1	Meteorological Operations and Advanced Situational Awareness	Advanced Weather Forecasting	New – FRMMA/WPMA	Exceeds regulatory requirements	All
4.5.2	Fire Spread Modeling	Satellite Fire Detection System	New – FRMMA/WPMA	Exceeds regulatory requirements	All
4.5.3	Weather Stations	Expanded Weather Station Deployment	New – FRMMA/WPMA	Exceeds regulatory requirements	All
4.5.4	Camera Deployment Strategy	Wildfire Cameras	New – FRMMA/WPMA	Exceeds regulatory requirements	All

**TABLE 16: ENHANCED SITUATIONAL AWARENESS AND KNOWN LOCAL CONDITIONS KEY
(CONTINUED)**

Section	Section	Program Mapping	New or Existing, Including and Recovery Vehicle	Regulation Compliance	Associated Drivers
4.5.5	Satellite Fire Detection Systems	Satellite Fire Detection System	New – FRMMA/WPMA	Exceeds regulatory requirements	All
4.5.6	Storm Outage Prediction Model (SOPP)	SOPP Model Automation	New – FRMMA/WPMA	Exceeds regulatory requirements	All
4.5.7	Wildfire Safety Operations Center (WSOC)	Wildfire Safety Operations Center	New – FRMMA/WPMA	Exceeds regulatory requirements	All

PG&E's Enhanced Situational Awareness and Known Local Conditions program was created to actively monitor and/or model potential wildfire occurrences and improve timeliness and response efforts, should an ignition occur. This program plays a key role in PG&E's PSPS program, as well as informing the Wildfire Recloser Disable Program and emergency response efforts. This program includes:

- Installing new weather stations at a density of one station roughly every 20 circuit miles in HFTD areas within PG&E's service area to provide detailed information about temperature, wind speeds and humidity levels. Data from these new stations will provide improved awareness of current fire danger conditions.
- Installing of a network of high-definition cameras that, when complete, will allow PG&E and fire agencies to monitor over 90 percent of PG&E's HFTD areas.
- Working with fire detection algorithm developers at the University of Wisconsin - Madison Space Science and Engineering Center to develop a next generation wildfire detection and alert system that uses satellite imagery to detect wildfires.
- Enhancing PG&E's existing SOPP to incorporate data from new weather stations and new modeling criteria in order to build advanced fire modelling capabilities into PG&E's existing meteorological models.

These new models will help provide advanced warning when weather changes indicate an increase in fire danger and will help PG&E make decisions about when to initiate operational risk reduction measures such as PSPS and the Wildfire Reclosing Disable Program.

In this section of the Plan, PG&E describes: (1) meteorological operations and advanced situational awareness; (2) fire spread modeling; (3) weather stations; (4) PG&E's camera deployment strategy; (5) PG&E's satellite fire detection system; (6) storm outage prediction modeling; and (7) the Wildfire Safety Operations Center or "WSOC."

4.5.1. Meteorological Operations and Advanced Situational Awareness

PG&E's Meteorology team continues to develop new techniques for forecasting fire danger as well as new tools to aid in providing real-time situational awareness during high fire danger conditions. PG&E utilizes state-of-the-art weather forecast model data and information from several public and propriety sources (e.g., the NWS, European Center for Medium Range Forecasting, Global Forecasting System) and from PG&E's proprietary in-house mesoscale forecast model, POMMS, to generate short and medium-term fire danger forecasts across the service area.

The POMMS is a high-resolution weather forecasting model that forecasts important fire weather parameters including wind speed, temperature, relative humidity, and precipitation down to 3-km resolution. Outputs from the POMMS model are then used in the National Fire Danger Rating System and the Nelson Dead Fuel Moisture (DFM) model to derive key fire danger indicators such as DFM, Burning Index, Energy Release Component and Ignition Component. These components are then scaled to produce fire danger ratings, the FPI, for operational use. The FPI is derived daily for 91 FIAs covering the HFTD areas within the PG&E service territory.

In late 2017, it became evident a more granular and real-time fire danger rating system would be needed for understanding and awareness of extreme events. PG&E's Meteorology team, with guidance from fire experts from SDG&E, and SJSU's Fire

Weather Research Lab, developed an enhanced version of the FPI to function as a real-time tool leveraging weather station observations. Several benchmarking sessions with SDG&E were conducted during FPI development. PG&E's Meteorology team plans to utilize a newly completed 30-year model reanalysis (climatology) across the entire PG&E territory along with historical fire occurrence to calibrate and scale this enhanced FPI as well as utilize it in forecast mode.

PG&E plans to further test and make any identified improvements to the POMMS modeling system in 2019 and beyond using High Performance Compute capabilities. Improvements including potentially altering the model configuration or increasing the resolution from 3-km to 2-km if model accuracy can be improved.

Each day, the FPI as well as Red Flag Warnings or Fire Weather Watches from the NWS determine fire danger ratings across the PG&E service area. Operational decisions to reduce the fire ignition risk go into effect each day there is a fire danger rating of "Very High," "Extreme," or "Extreme-Plus", a threshold selected, based upon historical-risk analysis. Daily emails are sent to impacted internal organizations including Electric Operations, Customer Care, Community Affairs, Government Relations, and others, which detail fire danger conditions; fire conditions are also discussed in a daily Electric Operations call.

Extended forecasts that cover a three- to seven-day forecast period are also provided daily to identify upcoming periods of heightened fire weather risk for advanced preparation. The updates provide information about offshore wind events, extreme hot and dry conditions, and dry lightning potential. This information, combined with weekly forecasts from the National Interagency Fire Center – Predictive Services for Northern California (ONCC) and Southern California (OSCC), give advanced warning about significant fire danger.

Lightning strikes cause thousands of fires each year across the United States. PG&E's operational Lightning Detection Network monitors cloud to ground lightning strikes in near real-time. Cloud to ground lightning strikes are recorded at ground

stations across the PG&E service area and are available and displayed in PG&E's geographic information systems. The PG&E Lightning Detection Network also sends email alerts of new lightning strikes to assist with monitoring of real-time events.

4.5.2. Fire Spread Modeling

PG&E also plans to deploy advanced fire spread modeling technology that produces hourly fire spread risk scores for circuits in HFTD areas. The technology to be deployed was chosen after benchmarking sessions with SDG&E. The system will run hundreds of million fire spread simulations daily for all PG&E overhead lines in and adjacent to HFTD areas. The main purpose of the fire spread modeling is to understand the total risk profile in the PG&E territory as well as the highest risk circuits or zones hour by hour for asset related fires of high consequence. The key piece of data is the probability of there being a fire of high consequence generated from any ignition point along Transmission and Distribution (T&D) lines in HFTD areas. The weather inputs utilized in each fire simulation will come from PG&E's POMMS weather model. Asset-based fire spread risk scores for areas potentially impacted by PSPS and circuits will be used to maintain situational awareness and used as an additional factor in considering de-energization. A methodology will be established to combine the fire spread risk score with existing systems for tracking and scaling the overall fire danger and the potential for ignition, specific to FPI and the SOPP model. The system will also be available to be run in real-time for specific existing fires to understand the predicted spread, which will inform public and employee safety, along with emergency management and response efforts.

4.5.3. Weather Stations

Data from weather stations installed in PG&E's service area will be used to help forecast and monitor for high fire-risk weather conditions to help inform implementation of additional measures such as PSPS. Data from these weather stations will also be used to validate model forecasts as discussed above.

PG&E operates more than 200 weather stations within its service area to obtain local weather data in real-time and these data are publicly available through the NWS. This data is utilized to assess current fire danger conditions to facilitate operational decision making and support safe operation of facilities. PG&E plans to deploy an additional 400 weather stations by September 1, 2019, doubling the installation pace from 2018.⁶¹ In the 2020 GRC PG&E forecasted installing approximately 1,300 weather stations in total within five years. Ultimately, PG&E may deploy more than or less than 1,300 stations as it continues to study and learn from these efforts, but 1,300 stations installed by 2022 is the best estimate at this time. It would take years to perform research and modeling to determine the optimum density of weather stations that would provide PG&E with clear knowledge of local conditions in its service territory. In the meantime, PG&E exercised judgment, considering knowledge of its service territory and other utility practices such as those of SDG&E, to decide the density of weather stations to install at this time, which will provide PG&E with sufficiently granular knowledge of local conditions to appropriately guide its wildfire risk reduction measures. The data collected from these stations are made publicly available in near-real time to benefit the public, federal, state, and local agencies.

4.5.4. Camera Deployment Strategy

Wildfire cameras are used by CAL FIRE, Cal OES, and PG&E to identify, confirm, and track wildfires. This allows firefighting agencies to be alerted quickly and to deploy resources directly to the areas where they can have the greatest impact. In 2018, PG&E piloted the installation of nine new cameras in HFTD areas to monitor for fires. In 2019, PG&E plans to install approximately 70 more high-definition cameras to increase PG&E and first responders' situational awareness in HFTD areas in PG&E's service territory. PG&E's goal is to establish roughly 90 percent coverage across these high fire-risk areas by 2022, which may require the installations of approximately

⁶¹ Since PG&E filed the 2020 GRC, PG&E has accelerated installation plans and doubled the number of weather stations it plans to install in 2019.

600 cameras. The high-definition, pan-tilt-zoom cameras will improve PG&E's overall situational awareness and be a valuable tool for assisting the WSOC, first responders, and fire agencies. The cameras currently planned for installation have near infrared capability and a web interface with time lapse functionality to assist with confirmation of fire reports, and monitoring fire progression and environmental conditions. First responders can control the cameras and use the live feeds to quickly confirm, locate, and respond to fires, and to provide that the right resources go to the right area.

4.5.5. Satellite Fire Detection System

PG&E's Meteorology team has deployed a beta version of a state-of-the-art satellite-based fire detection and alerting system and will make this system fully operational before the 2019 fire season. This system leverages fire detection data from the GOES-R series of satellites, as well as polar orbiting satellites MODIS and VIIRS. This system also has the capability to incorporate new fire detection data feeds as they become available. PG&E is working directly with fire detection algorithm developers with the Space Science and Engineering Center at the University of Wisconsin-Madison to procure a customized feed of satellite fire detection data with the lowest latency available. A PG&E-developed web application, modeled on SDG&E's program, displays fire detections as they become available and a customized algorithm monitors incoming fire detections and produces alerts when a new fire is detected. Fire propagation can be monitored as the data refreshes (GOES-R series satellites provide data across the U.S. every 5 minutes and every 1 minute in local areas). This tool will help PG&E react to new and emerging events quickly and make faster operational decisions. Once the system detects a new fire, PG&E plans to initiate fire spread simulations to understand the potential spread of the fire over the next 6 to 24 hours. The fire spread model will be coupled with PG&E's in-house weather model and fuel moisture models, which are discussed above.

4.5.6. Storm Outage Prediction Model

Unplanned outages can pose a fire ignition risk when surface fuels are extremely

dry. When strong winds and dry conditions are present, the risk of fast spreading and catastrophic wildfire increases. The SOPP, a storm damage prediction system developed, maintained, and operated by the Meteorology team on behalf of Electric Emergency Management, is the primary tool PG&E uses to reduce operational risk from adverse weather events that create a high volume of unplanned outages.

Functionally, the SOPP model is a collection of tools and techniques that are employed to predict unplanned outage activity. In its current form, the SOPP model relies heavily on an experienced meteorologist forecaster. PG&E will upgrade and automate the SOPP model to allow for less reliance on the forecaster and greater ability to provide more granular and frequent outage forecasts to support wildfire risk reduction. The result will be an objective weather risk dashboard, which can be updated in near real-time.

4.5.7. Wildfire Safety Operations Center

PG&E's WSOC is a physical facility that serves as the central wildfire-related information hub for PG&E, and monitors, assesses, and directs specific wildfire prevention and response efforts throughout its service area. The WSOC interfaces and collaborates with all lines of business (LOB) and CWSP departments to assist in the deployment of technology, processes and procedures directly related to wildfire prevention, response, and recovery. The WSOC develops the procedures for the WSOC Analyst and Duty Officers to effectively implement or deploy those technologies and resources. The WSOC also coordinates with PG&E's Public Safety Specialist team, which interfaces with CAL FIRE incident commanders and other AHJ incident commanders to oversee the organizational response to wildfire threats and incidents. The WSOC was established in 2018, and its functionality will continue to grow and evolve as situational awareness capabilities expand.

The WSOC monitors for fire ignitions across PG&E's service area in real time, leveraging PG&E weather stations, wildfire camera data, and publicly available weather information, as well as first responder and local and state data. Information also comes

into the WSOC from PG&E field personnel, including Public Safety Specialists and field observers. The WSOC deploys Public Safety Specialists to investigate reported wildfires to gather more incident specific information and report back to the WSOC. Based on incident specific information, the WSOC may create an incident report, which includes wildfire information, PG&E assets threatened or involved, current red flag status, and fire weather information. The WSOC will send the report to a pre-determined distribution list including field staff, control center personnel, executive staff, supporting LOBs and other PG&E emergency responders.

4.6. Public Safety Power Shutoff Program

TABLE 17: PUBLIC SAFETY POWER SHUTOFF PROGRAM KEY

Section	Title	Mapping	New or Existing, including cost recovery vehicle	Regulation Compliance	Associated Drivers
4.6.1	PSPS Decision Factors	Public Safety Power Shutoff	New – FRMMA/WPMA	Exceeds Regulatory Requirements	ALL
4.6.2.	Strategies to Enhance PSPS Efficiency While Reducing Associated Impacts	Public Safety Power Shutoff	New – FRMMA/WPMA	Exceeds Regulatory Requirements	ALL
4.6.2.1	Impact Mitigation Through System Sectionalizing	Granular Sectionalizing	New – FRMMA/WPMA	Exceeds Regulatory Requirements	ALL
4.6.2.2	Resilience Zones	Resilience Zones	New – FRMMA/WPMA	Exceeds Regulatory Requirements	ALL
4.6.2.3	Customer Services and Programs	Public Safety Power Shutoff	New – FRMMA/WPMA	Exceeds Regulatory Requirements	ALL
4.6.3	PSPS Notification Strategies	Public Safety Power Shutoff	New – FRMMA/WPMA	Exceeds Regulatory Requirements	ALL

**TABLE 17: PUBLIC SAFETY POWER SHUTOFF PROGRAM KEY
(CONTINUED)**

Section	Title	Mapping	New or Existing, including cost recovery vehicle	Regulation Compliance	Associated Drivers
4.6.3.1	Customer and Community Outreach	Public Safety Power Shutoff	New – FRMMA/WPMA	Exceeds Regulatory Requirements	ALL
4.6.3.2	Mitigating PSPS Impacts on First Responders, Healthcare Facilities, Telecommunication, and Water Utilities				
4.6.4	Re-energization Strategy				

A Public Safety Power Shutoff or “PSPS” is utilized by PG&E in accordance with Commission Resolution ESRB-8 “to protect public safety.”⁶² PG&E has developed and is continuing to refine tools and processes to identify applicable conditions, communicate possible impacts, and execute PSPS events. In developing the PSPS program, PG&E performed extensive benchmarking with SDG&E (the domestic utility with the longest history in pro-actively shutting power off to avoid wildfire events) in a variety of areas, including meteorology, operational processes, emergency response, restoration, communications and customer support.

PG&E modeled its PSPS processes and technologies on SDG&E’s, as PG&E understands them, to learn from their eight years of experience in this area. Particularly, PG&E emulated SDG&E’s methodology for deciding whether to initiate a PSPS event, its PSPS execution decision factors, its early stakeholder communication strategy (including with customers), its method to determine readiness for post-event patrols, and its method to verify the safety of overhead facilities before re-energization. PG&E also leverages a FPI modeled similarly to that of SDG&E, to identify higher-risk lines in correlation with applicable conditions. To further follow with SDG&E’s decision

⁶² See Resolution Extending De-Energization Reasonableness Notification, Mitigation and Reporting Requirements in D.12-04-024 to all Electric IOUs.

factors, PG&E is implementing several key enhancements in 2019, including increased density of weather stations, improved base meteorological modeling, and an enhanced FPI. PG&E is also engaging with the same company that developed an advanced fire ignition spread model for SDG&E to develop a fire ignition spread model tailored to PG&E's service area to help focus PSPS on the areas of highest risk.

While employing SDG&E's best practices, PG&E developed the PSPS program to fit the attributes of PG&E's service territory. Specifically, PG&E has adapted SDG&E's method to identify decision factors to apply to the unique conditions of PG&E's service area. For example, PG&E has a higher history of vegetation-caused outages than SDG&E due to the density of vegetation in Northern California and the higher circuit miles of overhead conductor. For this reason, PG&E may de-energize at lower wind speeds than SDG&E.

PG&E is focused on maturing this program to most effectively eliminate potential ignitions during extreme weather conditions. In 2019, lines considered for potential PSPS events will include all distribution and transmission lines at all voltages (500 kV and below) that traverse Tier 2 or Tier 3 HFTD areas. In comparison, lines considered for potential PSPS events in 2018 included all distribution lines and transmissions lines at 70 kV or below that crossed Tier 3 HFTD areas. This expansion of the PSPS Program increases the targeted distribution lines from approximately 7,000 circuit miles to approximately 25,200 circuit miles and the targeted transmission lines from approximately 370 circuit miles to approximately 5,500 circuit miles.

As PG&E expands PSPS to higher voltage lines within HFTD areas, it is developing a risk-based process, or Operability Assessments (OA), to assess the wildfire risk of individual transmission lines and structures. Through these OA, initially applied to transmission lines, PG&E will apply a risk-informed methodology to evaluate the potential risks of the line and impacts from de-energization. This risk-informed methodology will guide PSPS decisions, allowing PG&E to de-energize specific, targeted transmission lines to reduce wildfire risk and avoid indiscriminate

de-energization of transmission lines. This will facilitate compliance with federal reliability and operational requirements (e.g., North American Electric Reliability Corporation Reliability Standards, California Independent System Operator Corporation Tariff requirements) and limit wide-area grid reliability risk, while still reducing wildfire risk.

On December 13, 2018, the CPUC opened a rulemaking to examine utility use of de-energization, R.18-12-005. The CPUC acknowledged the relationship between that proceeding and the proceeding overseeing the implementation of SB 901 Wildfire Mitigation Plans (R.18-10-007). The CPUC recognized that Resolution ESRB-8 will remain in effect during the pendency of R.18-12-005 and stated that a detailed examination of de-energization will take place outside of the Wildfire Mitigation Plan Proceeding. Should the outcome of the Commission's separate but related de-energization proceeding direct PG&E to make changes to its PSPS Program, future plans will be revised accordingly.

In the remainder of this section, PG&E describes its: (1) PSPS decision factors; (2) strategies to enhance PSPS efficiency while reducing associated impacts; (3) PSPS notification strategy; and (4) re-energization strategy.

4.6.1. PSPS Decision Factors

No singular factor ultimately determines a PSPS decision. PG&E carefully reviews a combination of several factors when determining if power must be turned off for safety. These include:

- A Red Flag Warning declared by the NWS;
- Low humidity levels, generally 20 percent and below;
- Forecasted sustained winds generally above 25 miles per hour (mph) and wind gusts in excess of approximately 45 mph, depending on location and site-specific conditions such as temperature, terrain and local climate;

- Computer simulated ignition spread and consequence modeling based on current conditions;⁶³
- Condition of dry fuel on the ground and live vegetation (moisture content); and
- On-the-ground, real-time wildfire related information from PG&E's WSOC and field observations from PG&E field crews.

Generally, the first trigger for a potential PSPS event is a forecast of fire danger and high wind conditions by PG&E's Meteorology team. With the enhanced situational awareness from increased weather stations, and advanced modelling, PG&E's Meteorology team predicts conditions specific to local geographic areas. Once PG&E's Meteorology team has issued these forecasts, PG&E activates its Emergency Operations Center (EOC), with a designated Officer in Charge. Under the EOC structure, PG&E Planning and Intelligence, Operations, and other ICS teams continually monitor the latest weather forecasts as well as local conditions in areas forecasted for Extreme-Plus conditions. These teams continuously update the Officer in Charge of the real-time status of the factors listed above. While these conditions continue, the Officer in Charge will evaluate whether to call for a PSPS, based on these inputs. The foregoing describes PG&E's 2018 process, and we are continuing to evaluate our criteria to remove as much subjectivity from the decision-making as practical, but there is no singular algorithm that exists today that yields an objective result.

4.6.2. Strategies to Enhance PSPS Efficiency While Reducing Associated Impacts

4.6.2.1. Impact Mitigation Through System Sectionalizing

PG&E will continue upgrading devices with SCADA capability in targeted portions of the HFTD areas to help minimize the impact of PSPS events on customers in low-risk areas adjacent to the HFTD areas. These upgrades will include adding or replacing existing manually operated fuses and switches at strategic locations with new SCADA-enabled Fusesavers™, switches, or reclosers. By isolating the lines closer to

⁶³ This decision factor is being developed for use in 2019. PG&E previously had only ignition spread modeling based on historic climatology.

the border of the HFTD, fewer customers will be impacted and fewer lines will be de-energized. These improvements will also expedite restoration by reducing the amount of lines requiring a patrol.

4.6.2.2. Resilience Zones

PG&E uses the term “Resilience Zones” to describe projects that will allow PG&E to safely provide electricity to central community resources when PSPS is activated during Extreme-Plus conditions. Customers near Resilience Zones will benefit from the ability to access services such as grocery stores and gas stations while the wider grid is de-energized for safety. Host sites for Resilience Zones are selected in full coordination with the System Hardening Program for safe operation. Resilience Zones are still in a pilot phase, which will inform and dictate how the program should evolve in the future to better serve the needs of our customers.

Resilience Zones are enabled by pre-configured segments of the distribution system that can be quickly isolated from the broader grid when a PSPS is initiated. Using pre-installed interconnection hubs (PIH), PG&E will be able to quickly and safely connect temporary mobile generation to energize the isolated Resilience Zone. Generally, PIHs will consist of a transformer and associated interconnection equipment, ground grid, and grid isolation and protection devices (reclosers and switches). Resilience Zone PIHs may evolve into Resilience Zone Microgrids over time, as preferred resource combinations begin to meet technical requirements, and as PG&E’s capability to operate these systems matures. See Section 4.7.3 for more information on microgrids.

PG&E’s pilot Resilience Zone will operate as needed during 2019’s wildfire season in Angwin, a town situated within the Tier 3 HFTD area in Napa County (Fire Index Area 175). PG&E is working with Pacific Union College to align the operation of the Resilience Zone with the college’s privately-owned cogeneration plant to collaboratively increase resilience for the town of Angwin. Should Extreme-Plus conditions occur, the presence of the Resilience Zone will allow PG&E to safely

energize facilities such as the fire station, gas station, Brookside Apartments, and portions of the Angwin Plaza not already served by the local college's on-campus generation.

PG&E plans on expanding the Resilience Zone workstream for other towns that may be impacted by PSPS. The geographic scope of a potential Resilience Zone will depend on a range of factors including the current grid configuration and safety to energize during Extreme-Plus conditions. Resilience Zones will only be built in areas that meet the following criteria:

- Targeted sectionalizing in the area is not feasible due to grid configuration or other reasons; and
- The area has a sufficiently large hardscape and/or has been sufficiently de-risked of ignition danger through system hardening measures that a temporary mobile generator can safely run during Extreme-Plus conditions.

4.6.2.3. Customer Services and Programs

PG&E's first and most critical objective is to maintain safe grid power to as many customers as possible during potential PSPS events. This objective is achieved through a variety of strategic initiatives and programs as described throughout this Plan. PG&E acknowledges, however, that some customers will lose power during these events, and that it has a role to play in supporting our customers by providing services and programs to help alleviate the safety, financial, and disruptive impacts losing power can cause our customers.

Extending and Expanding 2018 Programs into 2019

PG&E currently offers several services and programs to our customers that can assist before, during and after an emergency including a PSPS event. These programs were available during the 2018 Wildfire season and will continue in 2019. These programs apply broadly to all types of customers and include:

- Proactive Communications: Respecting our customer's right to choose how they want to receive communications from PG&E, we provide a number of communication options, including: orchestrated proactive

notifications via text, email, interactive voice recording, and phone. However, during a PSPS event, PG&E leverages all communication channels to contact customers given the safety implications and potential disruption to their daily schedule. PG&E's electric customer base of 5.4 million premises could potentially be contacted if there is a valid phone number on file.

- 24/7 Information and Updates: PG&E's website provides customers with convenience and flexibility by allowing them to educate themselves on a variety of topics associated with wildfire preparedness. While customers can quickly identify areas impacted by weather or emergency events on the PG&E website, PG&E will also work closely with external media outlets to provide broader awareness, critical insight and capture crowdsourced feedback—all of which promotes more effective communication. In 2018, 2,380,153 customers visited pages related to outages and wildfire safety and preparedness.
- Experienced and Knowledgeable Business Teams: PG&E supports the unique needs of our largest industrial, commercial and agricultural customers with a dedicated team of over 60 account managers handling over 3,500 business customers. In addition to providing updates before, during and after an emergency, the account management team is available to work with critical customers to develop operational plans to prepare for an emergency. This team is assigned based on industry segments allowing for knowledge sharing of best practices and procedures.
- Live Customer Support: PG&E operates four contact centers in the state of California and provides 24/7 emergency live-agent service for customers to report emergencies. Our IBEW Contact Center agents are trained in how to handle customers dealing with natural gas and electric emergencies with specific procedures to escalate life-threatening situations. In 2018, our customer service agents handled

over 448,000 customer calls related to emergencies with an average speed of answer of 8 seconds.

- Mobile Neighborhood Answer Centers: PG&E maintains a local presence in our communities with the deployment of mobile answer centers to support customers during emergencies providing information on service restoration. Mobile answer centers provide a local alternative to live customer support over the phone, in pop-up locations throughout areas where the highest level of impacted customers reside.
- Customer Financial Relief: PG&E acknowledges the financial burden that customers may bear when impacted by an emergency. Over the years PG&E has developed a portfolio of financial solutions for our customers to provide immediate relief from worrying about their utility bill. PG&E offers financial support based on several factors and includes bill adjustments, extended payment plans, suspension of fees and low-income support for customers impacted by emergencies. This is further discussed in Section 5.2 of this Plan. In 2018, PG&E provided over \$4.7 million in financial relief to customers impacted by wildfires in 2017/2018.
- Personalized Service for Impacted Customers: PG&E provides a single point of contact for severely impacted wildfire customers to help assist with post fire details. This includes billing, claims, service planning, permitting, etc. This knowledgeable team of experienced and dedicated representatives can support a wide variety of customers or quickly route the customer to those who can assist. This team is currently slated to provide support to over 14,000 residential electric service points and 970 commercial electric service points.

Proposed New Initiatives for 2019 and Beyond

Given the anticipation that PSPS events will become more frequent due to extreme weather events, PG&E is actively exploring and developing additional services

and programs to support our customers during PSPS events. The Company is investigating a wide variety of solutions including commercially available products, partnerships with key community organizations, and services aimed to help our most vulnerable customers/communities.

PG&E's primary focus in the short term will be for those customers who require a continuous electric supply for life support, as well as critical services (i.e., telecom, water agencies, hospitals, and first responders) who provide life support services to our communities. PG&E will work closely with County OES to share information related to our most vulnerable customers to support local first responders in providing important local services to these customers during a PSPS event. PG&E will also continue to provide live customer support for critical services to provide real time updates and information regarding PSPS event impacts, duration, and restoration status.

Below is a list of the types of new programs PG&E is exploring:

- OEM & Retail Partnerships: Utilizing the existing back-up generation marketplace, PG&E would partner with major retailers and equipment suppliers to support onsite back-up generation systems that can provide continuous power during a PSPS event. PG&E would neither own nor operate this equipment, instead helping to facilitate the awareness and benefits an onsite system would provide during an emergency event. With the primary objective to aid in the streamlining of implementing a system that best supports the customer's overall choice and control of managing their energy/emergency needs.
- Collaborative Community Support: In coordination and partnership with local OES and other critical members of the community, community-based solutions would include initiatives such as "Enhanced Cooling Centers" to provide additional services to medical baseline, life support, and our most vulnerable customers. This collaborative effort comprised of community-based organizations, local stakeholders, and first responders would be designed to provide a safe, energized location for those most in need. Included would be the ability to support the

transportation of vulnerable residential customers to and from these centers.

- Grant Program: Partner and engage community-based organizations to develop a grant program to meet the needs of our most vulnerable customers.
- Continuous Power Programs: Continuing the education and support of commercially available options for Business customers (i.e., small business, mid-markets and large enterprise). Utilizing existing non-tariffed and account management channels to customize products and programs based on unique customer operating requirements.
- Partnership With Critical Services: PG&E will build on how it provides live customer support for critical services (i.e., telecom, water agencies, hospitals, and first responders); to provide timely updates and information regarding PSPS event impacts, duration, and restoration status.
- Coordination With Third-Party Commodity Suppliers: As more customers in PG&E territory purchase their gas or electric commodity from a supplier other than PG&E, we recognize the importance of providing Community Choice Aggregation (CCA) programs and Direct Access (DA) providers in our territory timely and relevant updates relating to PSPS events and Wildfire Relief efforts. Prior to PSPS events PG&E notifies CCA and DA providers of the potential PSPS event and the timing of prospective event. As the event gets closer, PG&E continues to provide updates to our CCA and DA partners that may impact our joint customers, including potential impacted customer lists, talking points and any timing changes that may occur. During the PSPS event PG&E CCA Account Managers provide daily updates to the CCA programs on timing, customer status and answer any questions or concerns the CCA brings up that come from our shared customers. As the metering and billing agent for many third-party suppliers, PG&E has worked closely with our partners to administer bill relief for severely impacted customers. PG&E

coordinates regular calls and provides data to third-party suppliers during and after emergency situations. In 2018, PG&E worked with over 50 third-party suppliers representing over 2 million customers.

PG&E will continuously refine and further develop strategies that minimize the extent of disruption of grid power, while enabling increased customer choice and control over safely managing energy needs during an emergency.

4.6.3. PSPS Notification Strategies

Recognizing that de-energization for public safety can burden communities with unintended risks and hardships, PG&E is committed to providing notice to government agencies and providers of critical services when extreme fire danger is forecasted, as well as continuing to refine its PSPS program to reduce the scope and severity of impact on customers.

PG&E will notify its primary government and agency contacts that PG&E is monitoring conditions and that extreme fire danger conditions may cause power outages or require PG&E to shut off power for safety in the coming days. For cities, counties and local agencies, PG&E will use a platform which can send the same message to a list of contacts through multiple channels including phone, text and email. Upon request, PG&E will provide city, county and agency officials with the content of its customer alerts, so they can be shared on channels such as Nixle, Nextdoor, and Reverse 911.

If a PSPS event is forecasted, PG&E will also attempt to send notifications to all potentially impacted customers when and where possible, before, during and after a PSPS event. Notifications will be made through various channels including IVR, text and/or email. When and where possible, PG&E will attempt to notify critical facilities such as hospitals, emergency centers, fire departments, water plants, water utilities/agencies, schools, and telecommunications providers (critical facilities) in advance of residential customers before an event occurs to help inform their preparedness efforts. During an event, frequent communication via live call outs with detailed event information will be provided to critical facilities to support operational needs if possible.

After an event, PG&E will prioritize critical facilities during restoration when and where technically possible. PG&E will do additional outreach to Medical Baseline and Medical Baseline-eligible customers so that PG&E has their contact information and they know how to prepare. If general notifications (IVR, text and email) are unsuccessful, PG&E will deploy personnel for an in-person notification.

4.6.3.1. Customer and Community Outreach

PG&E has performed significant community outreach to customers and first responders relating to PSPS events to enhance its ability to notify customers if a PSPS event is forecasted and help communities prepare for such events. In 2018, PG&E focused the first year of the program on making sure that the more than 570,000 homes and businesses served by lines in extreme fire-threat areas were aware of possible public safety outages and could take steps to prepare. In 2018, PG&E:

- Reached out to homes and businesses served by lines in extreme fire-threat areas through letters, postcards and emails to share information and help them prepare;
- Held over 450 meetings with community stakeholders (many of which were attended by a member of PG&E's senior leadership team) to talk about wildfire safety efforts and coordination;
- Hosted more than 20 regional informational workshops and open houses as well as additional public meetings and answer centers in key communities on CWSP and PSPS;
- Conducted direct outreach to customers who provide critical services such as hospitals, fire stations, water agencies and telecommunications providers that could be affected by a PSPS event;
- Reached out directly through mail, emails and automated calls to the 19,000 customers who are enrolled in our Medical Baseline Program, as well as direct outreach during the October PSPS event and potential PSPS event in November;

- Conducted outreach to master meter customers about PSPS and provided flyers to share with tenants to raise awareness and help them prepare for possible outages;
- Launched a dedicated website (pge.com/wildfiresafety) and created a search tool where customers can enter their address and learn if they are served by a line that may be turned off for safety during high wildfire threats;
- Continued earned, paid and digital media campaign to raise awareness about CWSP and PSPS and how customers can prepare;
- PG&E's VP of Electric Operations participated in the CPUC's December 2018 Public Safety Power Shutoffs Workshop;
- Communicated and coordinated closely with CPUC, Cal OES, CAL FIRE, and the Governor's office during the October 2018 PSPS event; and
- Provided ongoing support to local Fire Safe Councils through grants and other partnerships including co-sponsored events.

In 2019, PG&E is expanding and building upon these efforts to continue to help keep its customers and communities safe. PG&E intends to notify its 5.4 million electric customer premises of the potential for PSPS impacts and will continue to reach out to customers who live in or near high-fire threat areas. Information will include what customers can expect to experience in their community as a result of our ongoing and expanded wildfire safety efforts. We will continue to educate about steps customers can take to prepare for extreme weather and possible outages. These efforts include:

- Reaching out to customers served by lines in elevated or extreme fire-threat areas, through postcards, bill inserts and other mailers as well as email and social media;
- Supplementing direct communications with earned and paid media;

- Partnering with organizations who support our most vulnerable customer to explore opportunities to provide additional information and services;
- Ongoing briefings with city and county leaders, community leaders, first responders, local offices of emergency services and other public safety authorities to discuss our wildfire safety efforts and how PG&E can coordinate;
- Continuing to hold answer centers and open houses (where needed and appropriate) to engage with local community members and answer questions about our work;
- Looking at how PG&E can improve our PSPS notification processes and providing emergency services agencies with more detailed information and maps to assist with coordination efforts;
- Working to provide more frequent updates around estimated restoration times to customers and communities during a PSPS event through both direct notifications as well as local news, radio, social media and the pge.com website, when and where possible; and
- Doing additional outreach to Medical Baseline and Medical Baseline-eligible customers so that PG&E has their contact information and they know how to prepare.

4.6.3.2. Mitigating PSPS Impacts on First Responders, Health Care Facilities, Telecommunications, and Water Utilities

PG&E is performing direct outreach to customers who provide critical services, such as hospitals, fire stations, water agencies/water utilities and telecommunications providers to confirm PG&E has accurate contact information on file for notification purposes. Another important aspect of PG&E's direct outreach is the importance of having emergency operational plans in place in event of a PSPS. PG&E is committed to providing as much advance notice (as possible) so that our critical service providers

customers can be prepared to implement their emergency operational plans should a power shut down be necessary. PG&E is also committed to developing additional programs in collaboration with first responders, health care facilities, telecommunications, and water utilities. Pursuant to the ALJ Ruling, PG&E is including as Attachment B to this Plan a list of the entities that PG&E considers critical services for purposes of communications related to a PSPS event.⁶⁴

In addition, as mentioned above, PG&E will prioritize sectionalizing locations in a manner that evaluates the potential regional PSPS frequencies, with the goal to minimize the impact to critical customers in off-target areas.

4.6.4. Re-Energization Strategy

PG&E will only restore power following a PSPS event after confirming that it is safe to do so. Crews will patrol all facilities de-energized during a PSPS event to identify any damage that needs to be repaired before re-energizing. To reduce the outage impact to customers, PG&E will use helicopter patrols in areas where visibility is not limited by vegetation. PG&E assigns a task force consisting of supervisors, crews, troublemen, and inspectors to each circuit or portions of a circuit. This structure enables PG&E to patrol and perform step restoration in alignment with the impacted centralized control centers. Step restoration is when a substation is re-energized, and circuits are subsequently safely energized in segments as patrols continue. Any necessary repairs are conducted while patrols continue to allow for restoration to proceed as efficiently as possible.

4.7. Alternative Technologies

⁶⁴ ALJ Ruling, Attachment A at p. 5.

TABLE 18: ALTERNATIVE TECHNOLOGIES KEY

Section	Title	Program Mapping	New or Existing, Including Recovery Vehicle	Regulation Compliance	Associated Drivers
4.7.1	Rapid Earth Fault Current Limiter Pilot Project	Rapid Earth Fault Current Limiter Pilot Project	Existing – EPIC ⁶⁵	Exceeds regulatory requirements	Not Applicable
4.7.2	Enhanced Wires Down Detection Project	Enhanced Wires Down Detection Project	New – FRMMA/WPMA	Exceeds regulatory requirements	D1 – D6, D8
4.7.3	Other Advanced Technologies	N/A	N/A	Exceeds regulatory requirements	Not Applicable

PG&E is implementing pilot programs to evaluate alternative technologies that may harden and modernize the electrical system and improve operational capabilities. PG&E is implementing pilot programs to evaluate alternative technologies.

⁶⁵ Electric Program Investment Charge (EPIC) represents initiatives funded through the CPUC's EPIC research, development, and deployment grants.

4.7.1. Rapid Earth Fault Current Limiter Pilot Project

The Rapid Earth Fault Current Limiter Technology has been shown by the Victoria State Government (Australia) to directly reduce the risk of wildfires for single line to ground faults. PG&E has a demonstration project planned in 2019 to test the capabilities of this technology within PG&E's system. The Rapid Earth Fault Current Limiter technology consists of an inductor installed between the substation transformer neutral and ground and tuned to the line to ground capacitance of the circuits fed off of a distribution substation bank. In effect, this technology moves the neutral to the faulted phase during a fault reducing the potential to ground on that line to effectively zero (less than 250V) which significantly reduces the energy available for the fault.

4.7.2. Enhanced Wires Down Detection Project

PG&E has enabled single-phase SmartMeters™ to send real-time alarms to the Distribution Management System under partial voltage conditions (25-75 percent of nominal voltage). Prior to implementation, SmartMeters™ could only provide real-time alarms for the outage state. For three-wire distribution systems, the partial voltage condition indicates one phase feeding the transformer has low voltage or no voltage. Energized or de-energized wires down will create a low voltage condition on transformers through the mechanism of transformer back feed from the inactive phase to the fault. This enhanced situational awareness can help detect and locate downed distribution lines more quickly to enable faster response. Faster response may not only reduce the amount of time the line is down but may also allow first responders to more quickly extinguish wire down-related ignitions if they occur. PG&E is continuing to develop this solution to extend the enhancement to 3-Phase meters and 4-wire distribution systems.

4.7.3. Other Alternative Technologies

In addition, to the pilot programs, PG&E is researching other possible alternative technologies to determine whether they would be feasible and effective in system hardening. PG&E is evaluating emerging sensor technologies that enable real-time

system monitoring and situational awareness and is advancing the use of primary line sensor fault measurements in combination with CYME Power Engineering software fault calculations to display possible primary fault locations for targeting field patrol and accelerating fault locating. PG&E is also developing analytic and dashboard strategies to produce prioritized and actionable information from the correlation of data from multiple sources (e.g., SCADA, SmartMeter™, primary line sensors, and emerging sensor technologies).

Microgrids also continue to be a point of interest and optionality for both our customers and our internal operations in multiple contexts. The ability to island (to disconnect completely from the centralized grid) at key times can allow for sustained backup generation to critical facilities in communities working to respond and recover from wildfires and other natural disasters. PG&E is continuing to explore various paths to meet customer needs (resilience and other), as well as opportunities to support quicker recovery after a PSPS event is called.

4.8. Post-Incident Recovery, Restoration and Remediation Activities

TABLE 19: POST-INCIDENT RECOVERY, RESTORATION AND REMEDIATION ACTIVITIES KEY

Section	Title	Program Mapping	New or Existing, Including Recovery Vehicle	Regulation Compliance	Associated Drivers
4.8.1	Post-Incident Recovery	Not Applicable	N/A – unknown (fact specific)	Regulatory Compliance	Not Applicable
4.8.2	Restoration	Not Applicable	N/A – unknown (fact specific)	Regulatory Compliance	Not Applicable
4.8.3	Remediation	Not Applicable	N/A – unknown (fact specific)	Regulatory Compliance	Not Applicable

Each disaster has unique facts and circumstances. PG&E's post-incident approach empowers teams to rebuild and recover from a disaster safely, efficiently, effectively, and consistently. PG&E is committed to timely, well-coordinated activities between its Service Planning & Design, Gas and Electric Construction, and External Engagement teams.

Regardless of cause, rebuilding and recovery is required for any fire, flood, or explosion that causes damage of a magnitude that warrants major disaster assistance in repairing damage, mitigating loss, lessening hardship, or to alleviate suffering. Typical impacts of a disaster result in destroyed structures, threatened or crippled critical infrastructure, power outages, and forced evacuations. The intensity of disasters can vary on a case-by-case basis and affect utility customers differently, and for varying amounts of time.

4.8.1. Post-Incident Recovery

In the case of a wildfire, before post-incident assessment can begin, PG&E must secure CAL FIRE clearance to access the impacted area. PG&E line workers, inspectors, and estimators will then conduct a damage assessment of PG&E's electrical and gas infrastructure in the approved locations. The quantity of the personnel and timeline dedicated to this effort will depend on the extent of the damaged territory.

Minor asset corrections may be performed at this time where warranted to meet safety requirements.

The Customer Care team will, where appropriate, stand up mobile Answer Centers at appropriate locations. Information gathered during repopulation and via County OES, local fire, and other means can help inform and prioritize restoration and customers return home. Additional information on Public Outreach During and After Wildfires is provided in Section 5.1.3 of this Plan.

4.8.2. Restoration

PG&E will establish the appropriate level Incident Command Structure (ICS) and allocate resources to support the established restoration priorities following the procedures outlined in PG&E's Company Emergency Response Plan (CERP). PG&E will execute the restoration process, including all main line assets, after troublemen and assessment resources troublemen have identified which customers are safe to restore.

When and where possible, the Customer Care team communicate estimated times of restoration for extended outages. Once service is restored, normal billing and credit operations will resume.

4.8.3. Remediation

Community support and rebuild activities will be determined based on PG&E's analysis of the wildfire impact. PG&E will deploy its Remote Estimating Team to prepare designs, estimates, and job packages for critical infrastructure rebuild. Rebuild designs will be executed in accordance with PG&E's new fire-resilience infrastructure standards and design assumptions will be incorporated based on resilience and hardening plans considered. Critical infrastructure rebuild will be executed in parallel with estimating effort and also in accordance with fire resilience engineering standards. PG&E's line crews will rebuild transmission and distribution lines and supporting infrastructure so that it is operable and energized. The quantity of the crews required will be determined based on the extent of the damage. PG&E will assess longer term infrastructure rebuild requirements and determine recommended rebuild design. At this

time in some cases, PG&E may abate fire affected trees that pose a threat to utility lines and conductors and insulators may be cleaned based on the possibility that fire retardant was dropped on the line and/or particulate matter from the smoke plume could have caused a buildup on the line due to incomplete combustion during the fire.

4.8.3.1. Environmental Remediation – Debris Flow Modeling

A part of PG&E's remediation work is concentrated in the planning and response to debris flow hazards specific to the norther regions recently impacted by wildfire. Debris flows are gravity-driven mixtures of soil and water that are intermediate between floods consisting of water and solid to semi-solid landslides consisting of soil and rock. PG&E recognizes that the recent fires in northern California can result in elevated debris hazard due to the abrupt removal of vegetation that can retard hillside erosion, slow downward accumulation of sediment, and limit surface runoff during large storms. Localized erosion associated with debris flows can expose buried pipelines and can exert high impact forces to above ground structures, including electrical transmission towers, shipyards, natural gas facilities, and access roads.

PG&E's debris flow hazard prediction model integrates PG&E infrastructure, past debris flow datasets, local jurisdictional precipitation data, U.S. Geological Survey model results, and other datasets. The model was created to calculate debris flow thresholds and integrate this within PG&E's precipitation forecasts to rapidly predict the location and severity of debris flows in fire areas prior to major storm events.

The Debris Flow Watch is issued when a heightened state of awareness and monitoring is recommended. Work in areas along the base of steep slopes and drainages within and below fire burn areas should be approached with caution and personnel should at all times be cognizant of the surrounding land conditions and weather changes. Periodic check-ins should be conducted with all field personnel. The Debris Flow Warning is issued when continued monitoring of rainfall throughout this storm event indicates the potential for short-duration, intense precipitation that poses a heightened likelihood for initiation of debris flows within vulnerable slopes. The greatest

likelihood is in heavily burned areas at the base of steep slopes and downstream drainages but could also include areas of moderate slopes and along larger creeks.

PG&E's debris flow susceptibility maps show the relative probabilities for debris flow triggering within individual basins and along drainages with a focus on the orange and red zones of greatest concern. Work and personnel should be restricted at the base of slopes, drainages, and creek banks in the identified areas of concern until the Warning is terminated. Field crews should be specifically prepared to respond to debris flow occurrences in these areas and maintain a heightened state of alert with frequent EOC check-ins to obtain information updates and report observed debris flow activity.

To further improve PG&E's debris flow model estimates specific to the wildfire burn zones in northern California, Geosciences and Emergency Preparedness and Response (EP&R) are augmenting the collection and monitoring of rainfall intensity in the fire burn zones. The installation of rain gauges (using cellular or satellite technology) will improve our capability to monitor high concern areas in remote locations and augment NWS and PG&E Meteorology precipitation radar and local weather station data. This information, combined with systematic field reconnaissance (including visual and LiDAR-based mapping) is part of the program to improve debris flow assessment capabilities in northern California. The purpose of improved monitoring will help establish threshold rainfall intensities for debris flow initiation (currently $\frac{1}{4}$ inch in 15 min). These types of instruments are ideally suited to record rainfall in environmentally sensitive areas as part of PG&E's wildfire monitoring program as well. Long-term monitoring provides situational awareness of potentially hazardous earth movements during the recovery period.

5. Emergency Preparedness and Response

Pursuant to PUC Section 8386(c)(16) and the ALJ Ruling, this section of the Plan describes PG&E's emergency preparedness and response plan, including plans to prepare for and restore service after a wildfire and community outreach and customer support during and after a wildfire.

5.1. PG&E Company Emergency Response Plan

PG&E's overall emergency preparedness and response plan, filed pursuant to PUC Section 768.6 and GO 166, is referred to as the Company Emergency Response Plan or "CERP." PG&E's CERP and associated annexes, one of which is PG&E's FPP, are important tools to prepare PG&E for emergencies of all types.

PG&E's CERP assists personnel to respond in a safe, efficient, and coordinated manner to an emergency affecting gas or electric generation, distribution, storage, and/or transmission systems within the PG&E service area or the people who work in these systems. The CERP is an "all-hazards" plan that provides a broad outline of PG&E's organizational structure, describes actions undertaken in response to emergency situations, and presents a response structure that has clearly defined roles and responsibilities and identifies coordination efforts with external organizations (e.g., government, media, other gas and electric utilities, essential community services, vendors, public agencies, first responders, and contractors). The CERP consists of a base plan, appendices, and annexes. Annexes are detailed emergency response plans for specific operations, functions, or hazards.

PG&E utilizes common emergency response protocols and follows a recognized ICS. The CERP's all-hazards approach applies to any natural disaster or human-caused situation (e.g., fires, floods, storms, earthquakes, terrorist- or cyber-attacks) that threatens life and property or requires immediate action to protect or restore service or critical business functions to the public.

5.1.1. The Plan's Alignment With CERP

The Plan references PG&E's CERP, including specifically the Fire Prevention Plan. The Fire Prevention Plan is a comprehensive set of plans, procedures, processes, and activities related to the prevention, detection, response to, and recovery from ignitions that, if not suppressed, pose a risk of growing into a wildfire. In addition to employing the CERP in responding to wildfires as discussed below, PG&E maximizes the effectiveness of its CERP by:

- Providing its CERP to appropriate representatives from cities and/or counties within PG&E's service area every two years;
- Conducting meetings with these public agencies to provide an overview of the plan and to receive input;
- Working collaboratively with other utilities, participating in trade association meetings, and conducting benchmarking to identify emergency preparedness best practices;
- Reviewing disasters and emergencies that have affected other utilities, examining remedial actions taken, and incorporating updates to its plan, as needed;
- Preparing an after-action report following an activation of its EOC that identifies whether appropriate corrective actions or modifications need to be made to the CERP and other plans; and,
- Conducting annual corporate-wide exercise relative to our PSPS program and wildfire restoration, followed by a robust "After Action Review" and PMO program.

5.1.2. Plans to Prepare for and Restore Service

To support the development of an overall restoration and resource allocation strategy during a wildfire incident, PG&E uses a Restoration Work Plan tool to forecast the systemwide Estimated Time of Arrival and Estimated Time of Restoration (ETOR).

PG&E created the Restoration Work Plan tool to identify geographic areas that may need more personnel to support restoration efforts. The tool utilizes current and forecasted outage and resource counts to estimate the total time of restoration on systemwide, regional, and divisional levels. Historical assessment and restoration times for the current type of incident and geography drive resource productivity assumptions. By comparing the ETOR across all PG&E divisions, incremental resources can be directed toward those areas that need them most, and the need for mutual assistance crews can also be forecasted.

There are many cases where PG&E crews respond to a fire area and perform asset protection, such as pole pre-treatment, and fuel reduction activities ahead of a fire on and near the power line Right-of-Way (ROW) (with approval of the fire suppression AHJ Incident Commander at the Incident Command Post). Activities include:

- Asset Protection – Conducted with an approved wildland fire chemical applied to the base of the wooden facilities, thus helping to prevent ignition of the power pole from direct flame impingement or radiant heat.
- Vegetation Clearing/Fuel Reduction – VM crews may work ahead of the fire to reduce the fuel in and around the facilities and utility ROW using a variety of vegetation clearing/fuel reduction methods.
- Field Readiness – Field personnel will be made available to work directly with the fire suppression Incident Command to identify potential hazards and to provide a safe area for the public and the personnel working onsite. If the power lines need to be de-energized, the crews will perform the task for the fire control personnel. De-energizing the lines removes the likelihood of contact with an energized (hot) conductor should it come down from a burned power pole or be brought down by a hazardous tree or other conditions.
- Operational Controls – Onsite personnel will also be made available to work with fire suppression Incident Command personnel should a

change in tactics be necessary to protect critical generation, T&D system assets.

Once a wildfire is detected, one or more emergency centers may be activated, or other preparatory actions may be taken. These actions include, but are not limited to: conference calls, placing personnel on alert status, reviewing emergency plans, identifying key personnel available for restoration activities, pre-staging personnel, evaluating supplies and equipment, advising employees to pack overnight bags, and canceling or postponing non-critical meetings.

Each emergency center maintains call-out procedures for adequate staffing levels for any and every emergency. For escalating incidents, each LOB maintains appropriate notification processes, electronic mail and paging lists to notify personnel about the emergency and provide reporting and contact information. Personnel report to pre-designated emergency center locations or to another assigned location within the notified time period appropriate to the incident.

5.1.3. Emergency Communications

Emergencies underscore the need for strong communication with customers and the communities PG&E serves. PG&E's ongoing efforts to connect with customers and keep them informed—especially in a time of crisis— cover a variety of communication channels including, among others, our website, customer contact center, account management team, paid advertising, social media, proactive news stories, customer letters/emails/texts, videos, community meetings, customer answer centers, public notices, factsheets, and handouts.

In local emergencies, it is essential for field personnel to coordinate their activities with local public safety and other first responders to provide for the safe restoration of service. As an emergency grows, the necessity for internal and external coordination also grows. When activated, the EOC becomes the single point of coordination for information dissemination. PG&E provides information in many different languages depending upon the targeted population, including English, Spanish, Chinese, Vietnamese, Korean, Hmong, Tagalog, and Russian. PG&E understands that

information will change rapidly during an emergency and our commitment is to share timely updates with our customers. Below, PG&E provides the specific plans for communications before, during, and after a wildfire.

5.1.3.1. Public Outreach Before Potential Wildfires

PG&E communicates to customers and other stakeholders about efforts to prevent, prepare for, and respond to wildfires, as well as safety measures customers can take to help further reduce the risk of wildfires that might impact their homes, businesses, families, employees, or communities. As part of this outreach, PG&E conducts annual electric safety training for first responders, including law enforcement, fire departments, and public works and transportation agencies. PG&E also participates in annual joint exercises with first responders and emergency management partners to enhance and coordinate prevention and preparedness efforts. PG&E meets annually with local, state, and federal agencies and jurisdictions to share FPPs and strategies.

PG&E shares information with customers about the CWSP and other advice to help them prepare for and stay safe during extreme weather events. As part of this program, PG&E communicates directly about our programs including, among others, Situational Awareness including WSOC, PSPS, EVM, System Hardening, and WSIP efforts through its website, customer contact center, account management team, paid advertising, social media, proactive news stories, customer letters/emails/texts, videos, public notices, fact sheets and handouts.

As part of preparedness efforts, PG&E asks customers to visit pge.com/wildfiresafety to enter their address and find out if their home or business is served by an electric line that may be turned off for safety during high wildfire threats and to update their contact information. PG&E will use this information to alert customers in advance of turning off their electric service for safety, when and where possible, via automated calls, texts and emails. There is also information available on this website to help customers prepare a plan for their home or business.

5.1.3.2. Public Outreach During Wildfires

During a wildfire, PG&E conducts public outreach in a variety of ways. PG&E communicates with customers about safety and response efforts through its website, customer contact center, account management team, paid advertising, social media, proactive news stories, customer letters/emails/texts, videos and by attending community meetings as an incident is occurring to provide the latest information. To coordinate resources, PG&E may activate its EOC (at our headquarters in San Francisco), Regional Emergency Centers, and Operational Emergency Centers.

To assist in restoration and recovery, as appropriate, PG&E will stand up a base camp in impacted areas to mobilize resources and safely assess and restore gas and electric services. A team of highly trained and skilled communications and customer representatives are deployed as part of these mobilized response efforts to respond to questions from customer in affected communities, media requests, and local government inquiries in coordination with the EOC.

5.1.3.3. Public Outreach After Wildfires

Once first responders contain portions of a wildfire, PG&E begins work to safely assess for damage and restore gas and electric service to customers. This requires ongoing communication efforts with customers to provide the most up-to-date information about PG&E's response and recovery efforts.

PG&E communicates with customers about safety and response efforts through our website, customer contact center, account management team, paid advertising, social media, proactive news stories, customer letters/emails/texts, videos and by attending community meetings as an incident is occurring to provide updated information.

PG&E also provides detailed information about what services are available to customers who have been directly impacted by wildfires, ranging from bill relief to waiving certain fees to the rebuilding process and how to renew gas and electric service.

5.1.4. Ensuring Adequate Workforce to Restore Service

During any emergency event, PG&E personnel play a central role in restoring power to customers. Personnel must be organized, assigned, directed, tracked, and otherwise managed throughout the duration of an event, to effectively respond. Each emergency center maintains an emergency staffing plan and call-out procedure for adequate staffing for emergencies. For EOC personnel, the EP&R Director maintains an EOC On-call roster with appropriate contact information for key emergency response personnel and is responsible for issuing the call to activate the EOC.

PG&E's workforce undergoes regular trainings and exercises to provide an understanding of emergency preparedness and response plans and practices, in addition to providing an adequate number of qualified personnel to respond. PG&E also coordinates with other utilities and in trade association meetings on emergency preparedness and response issues and exchanges mutual support in large-scale emergencies.

Training is offered on multiple topics and formats, including on the job, in the form of tailboards, as web-based and instructor-led training courses, and through simulated emergency exercises. There is also annual field personnel training to prepare employees for fire season.

Restoring power after a wildfire is a complex task. A safe and expeditious restoration requires significant logistical expertise along with skilled line workers and specialized equipment. Electric or gas power utilities affected by significant outages will turn to the industry's mutual assistance network—a voluntary partnership of electric and gas companies from across the country—to help speed restoration. Mutual assistance is an essential part of the electric and gas power industry's service restoration process and contingency planning. The mutual assistance network is a cornerstone of electric utility operations during emergencies.⁶⁶

⁶⁶ Edison Electric Institute Mutual Assistance
<http://www.eei.org/issuesandpolicy/electricreliability/mutualassistance/Pages/default.aspx>,
 accessed March 29, 2018.

Different types of mutual assistance include, but are not limited to, utilizing local (utility to utility), in-state (California Utilities Emergency Association), regional (Western Region Mutual Assistance Agreement (MAA)), national (Edison Electric Institute (EEI) and American Gas Association), and specific hazard agreements (EEI's Cyber Mutual Assistance Program) which are established through a MAAs, and/or EEI's Resource Allocation Management Program. PG&E has agreements with other utilities to provide assistance on request by furnishing personnel, equipment, and/or expertise in a specified manner. These mutual assistance agreements: (1) are established prior to any specific incident; (2) follow standardized procedures; and (3) require specific authorizations before crews are provided/or received.

Finally, in addition to mutual aid support, PG&E also relies on contractors to help promptly restore service after a major wildfire event. PG&E has contracts in place to use contract crew and/or equipment resources during incidents where company resources alone are not able to restore our electric distribution and transmission infrastructure in a timely manner. Prior to emergency situations, PG&E's Sourcing Department issues contract agreements on an annual basis regarding assistance in restoring electric service during an emergency response. Agreements are established with contractors to provide assistance upon request and include providing personnel, equipment, and/or expertise in a specified manner. In day-to-day operations, PG&E's Sourcing Department works with contractors directly. During an emergency incident, the Planning and Intelligence Contractor Resources Unit is responsible for determining the number of crews needed, managing the contracts, and issuing emergency purchase orders.

PG&E requires contractors to become pre-qualified for safe work practices through PG&E's third-party, ISNetworld, as a condition of any contract award for "medium" or "high" risk work. In addition, contractors are required to confirm that their sub-tier contractors meet PG&E's pre-qualification criteria and have achieved a pre-qualification status through ISNetworld prior to performing any PG&E work.

Contractors are also required to confirm their employees and sub-tier contractors have completed all training required by law and any PG&E-specific required courses prior to conducting PG&E work.

5.2. Customer Support in Emergencies

Support for impacted customers is an important element of PG&E's post-event emergency response. Following the October 2017 Northern California wildfires, PG&E established a series of billing and service modifications and disaster relief to support customers. These measures, included in PG&E's Emergency Consumer Protection Plans, were adopted with Advice 3914-G-A/5186-E-A, effective December 22, 2017, in compliance with Commission Resolution M-4833. On September 7, 2018, PG&E revised its Emergency Consumer Protection Plan, as approved by Advice 3914-G-A/5186-E-A, for residential and non-residential customers in areas covered by a state of emergency proclamation issued by the Governor due to a disaster that affects utility services. This revised plan details the protocols for customer support during emergencies, including wildfires, and are summarized below.

In the sections below, consistent with the requirements of PUC Section 8683(c)(18), PG&E describes specific protocols and procedures related to customer support during and after a wildfire.

5.2.1. Outage Reporting

While PG&E's revised Emergency Consumer Protection Plan does not discuss outage reporting specifically, PG&E has implemented measures to notify customers of a potential electric outage caused by a PSPS event, or other planned or unplanned outages. Outside of customer notifications, PG&E includes emergency alerts and outage information on its website. Starting in 2019, separate colors are being used on the outage map to indicate which type of outage is or may be occurring.

5.2.2. Support for Low Income Customers

In the revised Emergency Consumer Protection Plan, PG&E proposed the following actions to increase support to low-income customers affected by a disaster for

counties covered by a state of emergency proclamation issued by the Governor of California concerning a disaster affecting utility services. With the exception of Relief for Energy Assistance through Community Help (REACH) support, PG&E proposed that the following actions apply to all low-income customers in the designated disaster area to align with California Alternate Rate for Energy (CARE) and Energy Savings Assistance's (ESA) use of county-based community organizations and to be able to apply low-income programs to persons displaced by a disaster:

1. PG&E suspends all CARE eligibility standards and high-usage Post Enrollment Verification (PEV) requests for all customers in impacted counties. PG&E will extend this measure to customers affected by a disaster for a period of one year from the date that the Governor's state of emergency proclamation is issued.
2. PG&E contacts its community outreach contractors and engages additional contractors to inform customers that PG&E will not select them for standard PEV or High Usage PEV for the CARE Program in the impacted disaster area.
3. PG&E communicates with the program administrator of REACH, a PG&E and customer-funded emergency assistance program, to request increasing the assistance cap amount for customers whose homes were red-tagged from \$300 to \$600. REACH funds will be made available for residential customers whose homes were red-tagged up to this new cap amount until funds are depleted.
4. Impacted and Red-Tagged⁶⁷ residential customers are eligible to qualify for ESA participation under PG&E's modified qualification requirements for a period of one year from the date that the Governor's state of emergency

⁶⁷ "Red-Tag" or "Red-Tagged" is a designation given by CAL FIRE or by local city and county governmental agencies and/or PG&E personnel to customers whose homes or businesses were destroyed.

proclamation is issued, if the customer lives in the designated affected county and they meet one of the following:

- a. The customer states that they lost documentation necessary for income verification because of the disaster; and
- b. The customer states that individuals displaced by the disaster reside in the household.

5.2.3. Billing Adjustments

PG&E will temporarily suspend bill estimation for customers identified within or near a disaster area. Once a premise is confirmed Red-Tagged by the County or PG&E personnel, PG&E will discontinue billing and issue a final bill. The final bill will contain charges for usage up to the last valid meter read prior to the start of the disaster. PG&E will also prorate any applicable monthly access charges or minimum charges when discontinuing billing for premises that have been Red-Tagged. For all other customers, post-evacuation, billing will commence after a valid read (based on actual usage) is received via the SmartMeter™ network or by field personnel. If an actual meter reading is unavailable after the evacuation order is lifted, PG&E will bill zero usage during the evacuation period and resume estimating of bills using PG&E estimating protocols.

There may be instances in which PG&E is unable to cease estimated billing attributed to the time period when a home or business was unoccupied, as there is no accurate way to immediately determine exactly which residences were evacuated and when. Evacuation areas are normally described in general terms, and historically customer lists for evacuation areas have not been readily available. PG&E works with CAL FIRE and/or Cal OES to obtain the most accurate information. In the event a customer received a bill with estimated usage during the time they were evacuated, they can contact PG&E, and an account review will be conducted to determine if a billing adjustment is necessary.

5.2.4. Extended Payment Plans

PG&E extends payment arrangements to impacted and red-tagged customers for any outstanding balances on their accounts for the length of time in which the Emergency Consumer Protection Plan is in place for a period of one year from the date that the Governor's state of emergency proclamation is issued. PG&E extends its most lenient payment arrangement term, which requires 10 percent down payment and a repayment period of 12 months, to customers within the designated affected area. Customers are eligible to pay off their outstanding balance sooner if they prefer. PG&E will adjust its technology protocols to enable this group of customers to use self-service technology (Web/IVR) to obtain these arrangements, in addition to calling our Contact Center to speak with a Customer Service Representative to complete this transaction.

5.2.5. Suspension of Disconnection and Nonpayment Fees and Deposit Waivers

PG&E provides the following protections for customers whose homes or businesses were Red-Tagged as a result of a disaster. PG&E will: (1) not disconnect service due to non-payment; (2) waive reconnection fees and return check fees; and (3) waive all security deposit requirements for customers seeking to re-establish service. These protections will remain in place for customers whose premises are Red-Tagged because of the disaster for a period of one year from the date that the Governor's state of emergency proclamation is issued. In addition, PG&E will not charge customers a late fee or report inactive residential customers whose properties were red-tagged because of a disaster to credit bureaus.

5.2.6. Repair Processing and Timing

Although PG&E's revised Emergency Consumer Protection Plan does not discuss repair processing and timing specifically, PG&E will use its best efforts to communicate the ETOR to customers during a PSPS event. Following a wildfire, PG&E will work with the impacted community to communicate priorities and timelines for repairs and restoration.

Repair timing is largely dictated by access to the fire area, total damage to PG&E assets, length of the affected lines, ability to secure materials and repair resources, and the priority of the customer. For example, hospitals, schools, water treatment plants, and other facilities deemed critical by the local community will receive a higher priority for restoration. In the event the fire's damage exceeds the restoration capacity of the local division, a base camp may be established to support the restoration crews, equipment, materials, housing, and incident command staff.

SMEs within operations provide the ETOR for individual outages using several different modeling tools depending on the type of emergency. Restoration timing for the entire affected area is estimated by calculating the projected restoration work hours and dividing by the available restoration crews.

5.2.7. Access to Utility Representatives

Although PG&E's revised Emergency Consumer Protection Plan does not discuss access to utility representatives specifically, multiple channels of communication are available to our communities before, during and after a wildfire, and include, but are not limited, to: PG&E's call center, customer service offices, public affairs representatives, and field teams.

6. Performance Indicators and Monitoring

6.1. Plan Accountability

6.1.1. Executive Level Responsibility

PG&E's Wildfire Risk Management VP is responsible for managing the execution of this Wildfire Safety Plan, annual compliance with PUC Section 8386, and overseeing the CWSP.

TABLE 20: RESPONSIBLE EXECUTIVE

Role	Title	Responsibilities
Head of Wildfire Risk Management efforts	Vice President, Community Wildfire Safety Program	Responsible for oversight and direction of wildfire risk management efforts.

6.1.2. Program Owners

The programs outlined in this Plan are assigned to the following roles as of January 27, 2019. PG&E is currently undergoing leadership re-alignment, and as a result the individuals and roles below are subject to change.

TABLE 21: RESPONSIBLE PROGRAM OWNERS

Program	Role
Operational Practices	Vice President, Electric Operations ⁶⁸
Enhanced Inspections – Transmission	Electric Operations Sr. Director, T-Line Enhanced & Accelerated Inspections & Repair
Enhanced Inspections – Distribution	Electric Operations Sr. Director, Wildfire Work Execution
Enhanced Inspections – Substation	Electric Operations Sr. Director, Transmission and Substation Risk Analytics
System Hardening	Electric Operations Sr. Director, Distribution Risk Analytics and Electric Operations Sr. Director, Wildfire Work Execution
Enhanced Vegetation Management	Electric Operations Director, Enhanced Vegetation Management
Enhanced Situational Awareness and Known Local Conditions	Vice President, Electric Operations ⁶⁹
Public Safety Power Shutoff	Vice President, Electric Operations ⁷⁰

⁶⁸ Position currently filled by Vice President, Customer Energy Solution.

⁶⁹ Position currently filled by Vice President, Customer Energy Solution.

⁷⁰ Position currently filled by Vice President, Customer Energy Solution.

**TABLE 21: RESPONSIBLE PROGRAM OWNERS
(CONTINUED)**

Program	Role
Alternative Technologies	Electric Operations Sr. Director, Distribution Risk Analytics
Post-Incident Recovery, Restoration and Remediation Activities	Incident specific – assigned as necessary post-incident; for example, the Vice President of Customer Energy Solutions is currently overseeing Camp Fire restoration
Emergency Response	Electric Operations, Director, Emergency Preparedness and Response
Customer Communications and Support	Customer Service, Director of Local Customer Experience

6.2. Plan Performance and Evaluation

The programs described in this Plan will be continuously reviewed, evaluated and modified as needed. In addition, ignition drivers are assessed regularly to allow for the continuous re-evaluation and re-design of wildfire risk reduction programs to continually improve the Plan's efficacy at reducing ignition. PG&E will monitor and evaluate both performance of the new strategies and programs described in this Plan and the Plan's efficacy in addressing wildfire risk through assessment of the following areas: (1) System Hardening; (2) Vegetation Management; (3) Operational Practices (e.g., PSPS); (4) Enhanced Inspections; and (5) Situational Awareness. Specifically, PG&E will use targets and indicators to evaluate Plan performance, as described below.

First, each year, PG&E will assess performance of the Plan by evaluating the degree to which it has met the targets set forth in Table 9. A **target** is defined as a specific goal that addresses either the work executed to reduce risk and/or the quality of the work executed. These targets will be refined each year to evaluate PG&E's performance against the goals outlined in the previous year's Plan and to continue to set goals constituting substantial risk reduction. PG&E will assess the extent to which it either (i) exceeds targets and consider potential increases for subsequent periods; or (ii) underperforms targets and identify and address challenges to improve future performance.

Second, as PG&E implements the Plan, it will analyze appropriate metrics –also called indicators – to assess the Plan's performance in reducing wildfire ignitions. An

indicator is used to identify and track a trend resulting from performance of the Plan programs. The indicators will be monitored and analyzed on an ongoing basis. Monitoring trends will help PG&E understand and evaluate the efficacy of the programs. PG&E can use this understanding to guide adjustments and reprioritization of the focus of the programs for continuing improvement.

To undertake the ongoing trend analysis of the indicators, PG&E will collect and analyze data (e.g., number of vegetation-caused outages in HFTD areas). In some cases, historical data is not available because of changes in systems or definitions (e.g., pre-2018 fire risk areas compared to HFTD areas, which were defined by the CPUC in 2018). As a result, PG&E will use available data and, on a going-forward basis, will collect the data required to complete the trend analysis.

PG&E recognizes that when dealing with natural systems it is impossible to predict with certainty year-over-year improvements in indicators, but anticipates that over time, with the investments in the programs and projects described above, the indicators will show improved trends (i.e., reduction in risk). To the extent that indicators do not show improve trends—or trends are not improving as quickly as expected, PG&E may reassess the programs or adjust targets.

Each of these work-performance and work-quality targets, as well as indicators, will be used to evaluate the efficacy of each of the major components of the Plan. Actual work performance targets for 2019 for each program in the Plan are set forth in Table 9 in Section 4 of the Plan. Select work performance targets are discussed in greater detail, as well as work quality targets and indicators, below.

Finally, PG&E has included targets that are intended to enable the CPUC to evaluate compliance with this Plan, as required under PUC Section 8386(h). Substantial compliance with the targets set forth in the Plan, once approved by the CPUC, should demonstrate that PG&E acted prudently and met the CPUC's "reasonable manager" standard, in regard to wildfire risk mitigation. However, as explained throughout this Plan, events outside of PG&E's control, such as qualified

personnel constraints, supply chain disruptions, or permitting and construction delays, could restrict PG&E's ability to meet all of the targets, and should be viewed by the CPUC in context when completing its subsequent compliance evaluation.

6.2.1. Operational Targets

Target #1 Number of Reclosers SCADA Enabled

- The number of reclosers that are converted to be SCADA enabled within the Tier 2 and Tier 3 HFTD areas each year to reduce wildfire risk and increase system resilience.
- The 2019 target is to SCADA enable approximately 285 reclosers in the Tier 2 and Tier 3 HFTD areas. The annual target will be assessed against the actual result achieved.

6.2.2. Inspection Targets

Target #1: Transmission and Distribution Structures and Substations Inspected

- Tracks the distribution and transmission structures and substations inspected under the enhanced inspection programs within HFTD areas and assesses the actual number of structures and substations inspected against the target in this Plan.
- The 2019 target is to inspect approximately 685,000 distribution poles, 50,000⁷¹ transmission structures, and 200 substations within the HFTD areas.

Target #2: Quality of Transmission and Distribution Inspections

- Tracks the quality of T&D Inspections.
- The target is met by achieving a 98 percent "meets expectations" performance during the internal audits.

⁷¹ Inclusive of 9,400 inspections completed in December 2018.

6.2.3. System Hardening Targets and Indicators

Target #1: Miles of System Hardened

- Retired miles of circuits with potential fire risk components within HFTD areas (as identified and prioritized by the distribution wildfire risk model generated in 2018) to reduce wildfire risk through either (1) rebuild of overhead circuitry to current design standards; (2) targeted undergrounding; or (3) elimination of overhead circuitry.
- The 2019 target is approximately 150 circuit miles of system hardening work completed. The annual target will be assessed against the actual result achieved.

Target #2: Quality of the Miles of System Hardening HFTD Areas

- The quality of the system hardening work completed annually in HFTD areas.
- The target is met by achieving a 100 percent “meets expectations” performance during the internal audits.

Indicator #1: Wires Down Events Within HFTD Areas

- The number of wires down events within HFTD areas, when the FPI is rated as very-high or higher, will be trended year-over-year.

Indicator #2: Equipment Caused Ignitions in HFTD Areas

- The number of equipment caused ignitions within HFTD areas will be trended year-over-year.

6.2.4. Vegetation Management Targets and Indicators

Target #1: Miles of Enhanced Vegetation Management Work Completed

- Completed distribution circuit miles of vegetation cleared under the EVM Program scope within high-fire risk areas to reduce

wildfire risk through (1) overhang clearing 4 feet vertical from conductor and (2) high-risk species mitigation.

- A circuit mile is recorded as complete when it is either inspected and determined clear, or when work identified by inspection is recorded as complete. Both overhang clearing and at-risk species mitigation must be recorded as clear/complete for the mile to be recorded as clear.
- The 2019 target is approximately 2,450 circuit miles of EVM work completed in HFTD areas. The annual target will be assessed against the actual result achieved.

Target #2: Completion of Drought and Tree Mortality (CEMA) Patrols

- Complete 100 percent of Drought and Tree Mortality CEMA Patrols by the end of 2019.

Target #3: Completion of Drought and Tree Mortality (CEMA) Work

- Removing or working all dead or dying trees (“CEMA trees”) identified by October 1 of the current year, excluding trees affected by third-party delays, including environmental permitting requirements, owner refusals, and agency approval or review.⁷²

Target #4: Quality Assurance Results in HFTD Areas

- Measures the results of QA review of EVM and Drought Response Program work performed on electric distribution power line segments within the HFTD area;
- Calculated as a percentage: the number of trees correctly worked to the EVM or Drought and Tree Mortality scope identified during audits divided by all in-scope trees reviewed through audits;

⁷² Due to physical and timing constraints, CEMA trees identified late in a calendar year likely cannot be removed in that same calendar year.

- The target is met by achieving a 92 percent “meets expectations” performance in the QA audits. Given that 2019 will be the first full year of the EVM program, QA review will be performed on 100 percent of EVM work.
- Any trees found to have been missed or incorrectly worked through the QA reviews will be reworked to meet the relevant program scope

Indicator #1: Vegetation Caused Outages in HFTD Areas

- The number of vegetation caused outages within HFTD areas, when the FPI is rated as very-high or higher, will be trended year over year.

Indicator #2: Vegetation Caused Ignitions in HFTD Areas

- The number of vegetation caused ignitions within HFTD areas will be trended year over year.

6.2.5. Situational Awareness Targets

Target #1: Weather Stations Installed

- Tracks the number of weather stations installed annually against the annual target.
- The 2019 target is to install approximately 400 additional weather stations. The annual target will be assessed against the actual result achieved.

Target #2: High-definition Cameras Installed

- Tracks the number of high-definition cameras installed annually against the annual target.
- The 2019 target is to install approximately 70 additional high-definition cameras. The annual target will be assessed against the actual result achieved.

6.3. Monitoring and Auditing

PG&E's Wildfire Risk Management organization is responsible for monitoring and auditing the targets specified in the Plan to confirm that PG&E safely and efficiently reduces wildfire risk and consequences within its service area. The Wildfire Risk Organization will evaluate actual performance compared to the targets on an ongoing basis – including at a minimum, annually, as well as rely upon the internal audits described below. The Wildfire Risk Organization will also examine indicators on a regular basis, including at least annually, to assess the efficacy of the Plan performance in reducing ignition risk. In addition, a third party selected from a list developed by the CPUC will audit PG&E's execution of the Plan annually.

This section of the Plan describes: (1) the correction of plan deficiencies; (2) monitoring and auditing the effectiveness of equipment and line inspections; (3) internal electric assessment management QA and QC process; (4) internal auditing; and (5) external auditing.

6.3.1. Corrections to Plan Deficiencies

Upon finding any deficiencies in performance against the Plan or need for improvement in the Plan itself, the PG&E's Wildfire Risk Management organization will be responsible for correcting the deficiencies.

6.3.2. Monitoring and Auditing Effectiveness of Equipment and Line Inspections

The CPUC performs between four and seven audits of PG&E's GO 165 Program on an annual basis. These audits review all parts of the program, including reviews of documentation, field validation of completed patrols and inspections, as well as a review of both pending and completed maintenance work identified on electric corrective action notifications.

In addition, Compliance Supervisors perform desk and field verification of a select number of Overhead and Underground facilities that were inspected in the

previous month. Facilities inspected by both PG&E and contractor Compliance Inspectors are verified including:

1. A minimum of four overhead and four underground facilities must be verified.
2. At least one location must be verified for each inspector that completed a GO 165 Inspection in the previous month.
3. If less than four Compliance Inspectors completed inspections in the previous month, the number of verifications must be split between the inspectors so that the minimum four verifications are performed (for example, three inspectors that performed overhead inspections must have a verification performed for each of the three inspectors and an additional verification performed for one inspector). The additional verification will be rotated between the inspectors in subsequent months.
4. If more than four Compliance Inspectors completed inspections in the previous month, the number of verifications must be equal to the number of inspectors. For example, six verifications are required if six inspectors performed overhead inspection.

6.3.3. Internal Electric Asset Management Quality Assurance and Quality Control Process

The Quality Management (QM) Department within the Electric Asset Management (EAM) organization, executes the Electric Operations QA and QC Program. This program performs independent quality audits and control tests of the electric LOBs. This includes Electric Transmission (Substation and Transmission Lines), Distribution, and Transportation Services. Quality Management has three separate groups: (1) QC Transmission Line and Substation; (2) QC Distribution; and (3) QA.

The QM auditing program procedures and methodologies must satisfy the following principles:

1. Consistency With the Following Standards:

- ASQ/ANSI/ISO 19011:2011: Guidelines for auditing management systems
- American Society of Quality (ASQ) Code of Ethics

2. Transparency

- QM has the obligation to report truthfully ensuring that assessment findings, audit reports, and conclusions reflect the assessment activities and observations.

3. Independence

- Assessments are performed by personnel who do not have direct responsibility for performing the activities being assessed. They must be free from bias and conflict of interest to maintain an objective state of mind throughout the assessment process so that findings and conclusions are based only on the objective evidence.

QM uses an integrated approach to plan and coordinate audits. Specifically, QM uses an Audit Plan Committee and applies a risk-based methodology to prioritize audits and control tests to be performed. The Audit Plan Committee consists of leadership from Quality Compliance, T&D Compliance, Risk, and LOBs tasked with identifying, refining, and prioritizing quality audits, assessments, and control tests. The Audit Plan Committee meets twice a year to publish a rolling 12-month audit plan. The QM department is designed to focus on the relevant LOB standards and compliance requirements.

In addition, on an as needed basis, both QC groups (T&D) perform focused audits on the restoration efforts during emergency response events.

6.3.4. Internal Auditing

Internal Auditing (IA) provides PG&E with independent, objective assurance of the adequacy of processes and controls to manage business risk. IA's scope of work is to determine whether PG&E's processes, as designed and implemented, are adequate

for (a) identifying and managing key risks; (b) producing accurate, reliable, and timely operating, managerial, and financial information; (c) protecting PG&E resources; (d) complying with applicable laws and regulations, policies, standards, and procedures; and (e) providing an appropriate level of internal governance.

IA does not have mandatory annual audits focused on these processes. Rather, as part of PG&E's process to develop the annual audit plan, IA assesses all risks, including electric Distribution, Transmission and Substation risks. As a result, each year IA typically performs audits over a variety of processes across electric Distribution, Transmission, and Substation.

6.3.5. External Auditing

PG&E is currently conducting a solicitation seeking a third party to review various aspects of the risk reduction measures as part of its CWSP including WSIP. Depending on the quality of performance and value received from the third-party entity, the process may be expanded further to additional potential risk reduction measures.

7. Cost Estimates for 2019 Plan Programs

As required by the ALJ Ruling, in Attachment E, PG&E provides initial cost estimates for each program within this Plan, so that the CPUC and parties may weigh the potential cost implications of measures proposed.⁷³ The costs reflect PG&E's best estimate of the costs for the proposed programs as of January 31, 2019. Actual costs may vary substantially depending on actual conditions and requirements; costs of labor (impacted by both rate per hour and actual time required to complete work), materials, permit acquisitions, or other necessary resources; weather or other environmental or climatological factors; challenges regarding access rights to perform the work; the projected scope of the program; as well as additional execution risks listed in Table 9.

For three of the larger programs, in addition to the general potential variables noted above, the following are incremental key drivers of our cost estimates for these specific initiatives:

System Hardening:

- Percent of system hardening performed above ground versus underground;
- Ability to secure adequate trained personnel to complete the work;
- Ability to secure necessary equipment and materials to complete the work (e.g., limitations on available conductor);
- Actual number of miles completed;
- Technological improvements/advancements;
- Economies of scale captured in estimates;
- Mix and number of crew required to complete the work per line mile;
- Mix of materials required to complete the work per line mile;

⁷³ ALJ Ruling at p. 2.

- Our ability to get appropriate clearances due to customer impacts; and
- Ability to bundle work with other efforts.

WSIP Inspections & Repair (transmission, distribution and substation):

- Ability to secure adequate trained personnel to complete the work;
- Ability to obtain appropriate clearances due to system, customer or landowner impacts;
- Actual number of miles completed;
- Extent and type of damages found during the inspections; and
- Ability to bundle work with other efforts.

Vegetation management activities:

- Ability to secure adequate trained personnel to complete the work;
- Actual number of miles completed;
- Volume and type of vegetation identified as requiring work (trim or removal) to meet program scope during inspections;
- Mix of tree trimming required (overhang vs ground to conductor fuel reduction); and
- Mix of trees types (species, heights, diameter, adjacency to other structures or facilities), which impacts level of tree workers and time required to remove a tree.

To most reasonably compare current program costs, PG&E has included the 2019 forecasted spend for those programs in columns labeled “*Costs Currently Reflected in Revenue Requirement? (Provide Decision Reference) If for Only Part of Budget, Identify the \$ for that Part and Explain Part Not Previously Authorized (§ 8386(j)).*” For the costs that are partially recovered in the revenue requirement, several of the program costs have yet to be listed in Attachment E, Cost Estimates for

2019 Plan Programs, and will be submitted to the CPUC subsequently following submission of this Plan. The costs forecasted in Attachment E generally align with those forecasted for 2019 in the 2020 GRC filing. Program cost forecasts that deviate from 2020 GRC (or other previously filed documents e.g., CEMA, EPIC & FHPMA) by approximately 15 percent or more from PG&E's latest forecast have been updated with PG&E's latest forecasted costs. The reasons that the program costs have changed are discussed below.

There are program costs in this Plan that deviate from previously forecast costs. These include the following programs (identified by the section in which they are discussed in the Plan):

- 4.1.3 Safety and Infrastructure Protection Teams: The 2019 cost represented in the CEMA forecast has increased due to the size of the workforce supporting this effort.
- 4.1.4 Aviation Resources: The cost forecasted for 2019 in the 2020 GRC has decreased as PG&E brought the purchase of the helicopters forward into 2018.
- 4.2.4 – 4.2.7 WSIP, Distribution, Transmission and Substation Inspections: The WSIP inspection programs were developed after submission of the 2020 GRC filing and are an incremental wildfire safety cost.
- 4.4 Vegetation Management CEMA Related Costs: The 2019 CEMA forecasted costs have decreased because it was determined that *Fuels Reduction* would be recorded in *the Enhanced Vegetation Management program* for 2019 and thus that portion of the previous CEMA forecast will now be recorded in the 2019 FHPMA. The forecasted number of dead and dying requiring removal has also dropped due to recent trends, including PG&E's significant efforts in recent years to remove these trees, which has reduced the 2019 CEMA forecast as well. In addition,

firefighting crews were included into the original 2019 CEMA forecast, but have since been removed.

- 4.5.2 Weather Stations: The number of weather stations targeted for installation in 2019 has increased from 200, listed in the 2020 GRC filing, to 400 after the submission of the 2020 GRC.
- 4.5.6 WSOC: The WSOC labor component has increased from the 2019 test year forecast as submitted in the 2020 GRC due to additional Public Safety Specialist and WSOC Full Time Employees.
- 4.6.2 PSPS: The forecasted number of PSPS events has increased from the 2020 GRC in response to expansion of the scope.

The ALJ Ruling also requires each utility to explain how it will avoid double counting of costs. PG&E will track the costs incurred for each program by date and planning order, ensuring that costs are not double-counted. Each program's costs will be allocated to the appropriate memorandum account, balancing account, or budget, based on whether the costs are incremental or were included in existing revenue requirements. Where a portion of a program's costs were included in the 2017 GRC, and therefore in the current revenue requirement, PG&E will deduct the proportionate amount from the memorandum account.

8. Additional Information the CPUC May Require

PG&E has developed this risk-informed Plan to reduce the highest wildfire risks within its service area. By prioritizing the highest risk circuits in HFTD areas, PG&E will focus available resources to address the greatest risks. As indicated in the summary chart in Section 4, there are challenges that PG&E is already preparing to address to effectively and expeditiously implement the Plan and achieve PG&E's identified 2019 targets.

There are additional circumstances that could also impact PG&E's ability to successfully implement this Plan. On January 29, 2019, PG&E filed for Chapter 11 under the U.S. Bankruptcy Code in the United States Bankruptcy Court for the Northern District of California. While PG&E expects that this process will assure the Company has access to the capital and resources necessary to support ongoing operations and enable PG&E to continue investing in its systems, infrastructure and critical safety, it is possible that financial issues could hinder PG&E's ability to retain the resources or otherwise fund activities required by the Plan. In addition, during this process, PG&E's activities and expenditures will be subject to review by the Bankruptcy Court.

Finally, this Plan supplements, but does not supersede, PG&E's wildfire related documents, including but not limited to:

- 2020 GRC
- PG&E's Fire Prevention Plan
- PG&E's Wildfire Annex to the CERP
- TD-1464S

PACIFIC GAS AND ELECTRIC COMPANY
ATTACHMENT A
FIRE POTENTIAL INDEX METHODOLOGY AND BACKGROUND

ATTACHMENT A

Fire Potential Index Methodology and Background

Summary

In 2018, Pacific Gas and Electric Company (PG&E) Meteorology, with guidance from fire experts from San Diego Gas & Electric Company (SDG&E), the United States Forest Service (USFS), and San Jose State University's Fire Weather Research Lab, developed the Fire Potential Index (FPI). The central purpose in the development of the new FPI was to create a system that could be optimized to forecast and track fire danger in real-time, a capability that has historically been unavailable when utilizing the National Fire Danger Rating System (NFDRS).

The FPI combines fire weather data (temperature, humidity and wind), live and dead fuel moisture values, and satellite data to rank fire danger on a floating-point scale from 1 (lowest) to 6 (highest), allowing for a more detailed determination of fire danger at the extreme end of the fire danger scale. Threshold values for each rating classification are determined through an evaluation of conditions during historical fire incidents combined with typical seasonal values. The FPI was applied to 91 static geographic areas that are called Fire Index Areas (FIAs);¹ these geographic areas include all Tier 2 and Tier 3 areas as designated by the California Public Utilities Commission (CPUC) High Fire-Threat District (HFTD) Map where PG&E has electric transmission and/or distribution equipment.

The FPI is also combined with PG&E's damage prediction model to better distinguish between typical Extreme fire danger observed during hot and dry conditions, and Extreme-Plus fire danger, which occurs when a confluence of strong, dry, outage producing winds and extremely dry fuels may lead to devastating wildfires.

Background

Prior to 2015, PG&E received fire danger ratings directly from California Department of Forestry and Fire Protection (CAL FIRE) for FIAs in PG&E's service territory. When CAL FIRE discontinued this service in December 2014, PG&E decided to develop a fire danger rating methodology utilizing public and internal data sources to

¹ FIAs were originally developed by the USFS Pacific Southwest Forest and Range Experiment Station (now the Pacific Southwest Research Station) in 1959 and updated in the late 1960s and are still in use today by state (e.g., CAL FIRE) and federal agencies (e.g., USFS). These agencies refer to these areas as Fire Danger Ratings Areas.

implement actions that could reduce fire ignition risk. PG&E developed and demonstrated a Fire Danger Rating System specific to PG&E's service territory under the Electric Program Investment Change (EPIC) 1.05² Program.

The EPIC 1.05 Project Team conducted a review of existing and publicly available fire danger ratings systems and consulted with multiple partners to further refine PG&E's fire danger rating methodology, given the need to evaluate fire danger ratings at a more granular timescale and spatial resolution. A more granular fire danger rating methodology was developed, tested, and deployed, specifically to provide daily fire danger ratings for PG&E's service territory. Key project partners provided valuable guidance and consulting and participated in at least one of two external sharing and coordination meetings. They included:

- CAL FIRE
- USFS
- National Weather Service
- SDG&E
- San Jose State University (SJSU) Fire Weather Research Lab
- Bureau of Land Management
- California Governor's Office of Emergency Services (Cal OES)
- PG&E's Wildfire Risk Council

The result was a system utilizing outputs from the PG&E Operational Mesoscale Modeling System (POMMS), NFDRS³ and the Nelson Dead Fuel moisture model.⁴ This system allows PG&E to forecast the fire danger rating from low to extreme on an hourly basis for each FIA, and is consistent with how CAL FIRE, the USFS, Bureau of Land Management, and Bureau of Indian Affairs evaluate fire danger.

FPI Components

Following the devastating wildfires in October 2017, it became evident that an even more granular fire danger rating system would be needed for understanding and

² Voss, M.G EPIC. 2016. New Forecast Methods for Improved Storm Damage Modeling.

³ Deeming, J. E., J. W. Lancaster, M. A. Fosberg, R. W. Furman, and M.J. Schroeder. 1972. The National Fire-Danger Rating System. U.S. Department of Agriculture Forest Service, Rocky Mountain Forest and Range Experiment Station, Research Paper RM-84, Ft. Collins, Colorado. 165 pp. Revised 1974.

⁴ Nelson, Ralph M. Jr. 2000. Prediction of diurnal change in 10-h fuel stick moisture content. Can. J. For. Res. 30: 1071-1087.

awareness of extreme events. Not only did the FPI provide the fire danger ratings for more precise geographic areas (the 91 FIAs), but the FPI could provide hourly fire danger ratings that could be modeled/forecasted and then tracked in real-time.

The FPI is calculated based on weather conditions and the state of the fuels. A sample is included below, with additional detail on specific conditions and components that factor into the FPI calculation.

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Index	Rating	Fosberg Fire Weather Index (FFWI)
1 - 2	Low	<15
2 - 3	Moderate	≥15 - 25
3 - 4	High	≥25 - 40
4 - 5	Very High	≥40 - 60
5 - 6	Extreme	≥60 - 100

Varies minutes to hours

FPI = Fire Potential Index = Weather Conditions (FFWI) + Fuel Conditions

- FFWI (Fosberg Fire Weather Index) combines wind, humidity, and temperature
- Fuel Conditions: Dead Fuel Moisture, Live Fuel Moisture, and Enhanced Vegetation Index (i.e., Green-up)
- FPI calculated for each Fire Index Area; all variables scaled 1 to 6

$$FPI = \left(\frac{\text{Weather} + \text{Fuels}}{2} \right)$$

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DFM

Index	Rating	10 hr. Dead Fuel Moisture (DFM)
1 - 2	Very Wet	> 25%
2 - 3	Moist	≤ 25 - 12%
3 - 4	Dry	≤ 12 - 8%
4 - 5	Very Dry	≤ 8 - 5%
5 - 6	Extreme	≤ 5 - 1%

Varies over hours to days

LFM

Index	Rating	Live Fuel Moisture (LFM)
1 - 2	Very Wet	>100%
2 - 3	Moist	≤100 - 81%
3 - 4	Dry	≤80 - 71%
4 - 5	Very Dry	≤70 - 63%
5 - 6	Extreme	≤62 - 45%

Varies over days

EVI

Index	Rating	Enhanced Vegetation Index (EVI)
1 - 2	Very Green	0 - 20%
2 - 3	Green	≥20 - 40%
3 - 4	Transition	≥40 - 60%
4 - 5	Curing	≥60 - 80%
5 - 6	Mostly Cured	≥80 - 100%

Varies over several days to weeks

Weather Conditions

The FPI weather component is calculated using the Fosberg Fire Weather Index (FFWI), an established tool widely used by land managers to evaluate the impacts of short-term weather variations as they relate to fire potential. The FFWI processes meteorological variables (relative humidity, temperature, and sustained wind speed) through a non-linear filter that results in a linear relationship between combined meteorological variables and wildfire behavior. The FFWI is based solely on weather data and can assess potential wildfire behavior over shorter timeframes and in localized areas where high-resolution model data or surface weather observations are available. FFWI values are sourced from POMMS and are calculated at each weather station in a given FIA. Multiple weather stations are mapped to individual FIAs. Web tools can also be utilized in real-time during high fire danger events to ascertain how models compare to actual conditions, thereby providing situational awareness of real-time fire danger conditions.

Fuel Conditions

Fuel conditions are measured through a combination of dead fuel moisture (DFM), live fuel moisture (LFM), and a satellite-derived greenness factor, or Enhanced Vegetation Index (EVI).

Dead Fuel Moisture (DFM)

Most Dead Fuel Moisture can be found on the forest floor and consists of moisture content from organic dead fuel. DFM levels are calculated by gathering data on variables like temperature, humidity, length of day and accumulated rain; as such, DFM data is constantly evolving. DFM values are calculated for each FIA and assigned a 1-to-6 value based on historical thresholds.⁵

Live Fuel Moisture (LFM)

Live Fuel Moisture is the moisture that occurs naturally in living vegetation; more specifically, it is the ratio of water weight to dry weight in any particular sample. Data for LFM is expressed as a percentage; a metric of 100% signifies a sample of vegetation consisting of 50% water. In California, LFM values have been found in excess of 200%.⁶ Unfortunately, LFM measurements have also been sparse and lacking in agency coordination. Inconsistencies with sampling equipment and methods have also contributed to uncertainty in these analyses; PG&E is working with the SJSU Fire Weather Science Lab to better understand and improve LFM measurement and modeling. As with DFM, LFM is scaled from 1-to-6, with 1 signifying significant wetness and 6 as the driest possible.

Enhanced Vegetation Index (EVI)

The Enhanced Vegetation Index is an index that is derived from satellite data that detects and tracks the condition (green to cured) of vegetation. EVI is particularly useful when tracking the life cycle of annual grass crops but can also be leveraged to determine areas of intense bark-beetle damage or drought impacts. The life cycle of plants from 'Green-up' to transition to completely cured can be both modeled and observed. As annual grasses and perennials flourish, fires are much less likely to start and spread; as annual grasses begin to transition, usually in late spring into summer,

⁵ Ref Nelson, R.M., Jr., 2000. Prediction of diurnal change in 10-h fuel stick moisture content. Canadian Journal of Forest Research, 30:1071-1087.
<https://pdfs.semanticscholar.org/3022/2d17ecc4c3ff15b029602329436c13594e22.pdf>.

⁶ National Wildfire Coordinating Group S-290 Intermediate Wildland Fire Behavior Course Unit 10.

and then cure in the summer and into fall, the probability of fire ignitions increase. Plant cycles are dependent on atmospheric conditions such as the timing and amount of rain (soil moisture) temperature, wind (ventilation) relative humidity and solar radiation. The PG&E FPI utilizes a 'Green-up' component that is scaled from 1-to-6 and is based on EVI percentile calculations; this data is generally updated every 8 days.

Extreme-Plus Fire Danger

In 2018, PG&E created a new Extreme-Plus fire danger category to better distinguish between the more typical extreme fire danger observed in California during hot and dry conditions and the rare concurrence of extreme fire weather conditions (strong, dry, outage producing winds) with extremely dry fuels. The Extreme-Plus fire danger category seeks to capture conditions that may lead to ignitions of rapidly spreading catastrophic wildfires. Extreme-Plus conditions are gauged on a scale that combines PG&E's storm damage model with its fire danger model (FPI); the storm damage model's underlying logic seeks to predict the likelihood of outages, caused by either equipment or vegetation, that could become an ignition source. An Extreme-Plus fire danger forecast is a principal factor in consideration of a Public Safety Power Shutoff (PSPS) event, which is a program that PG&E implemented following the 2017 wildfires as an additional precautionary measure to further reduce the risk of wildfire ignitions. An Extreme-Plus rating is not considered final or published internally until it is vetted by the supervising meteorologist and reviewed in conjunction with leadership from the Community Wildfire Safety Program and the Wildfire Safety Operations Center.

Storm Damage Modeling (SOPP)

PG&E's Meteorology department supplies Electric Operations with daily weather guidance; this guidance includes Storm Damage Modeling (SOPP), which highlights potential adverse weather across the PG&E service territory over a 10-day timeframe. SOPP details any expected outage activity in each of PG&E's 19 geographic Divisions over a 4-day period, along with an estimate of the number of troublemen and crew resources required for assessment and repair. SOPP is also able to project the expected timing of meteorological risk during weather events and assign a scale of 1-to-5 to each division depending on forecasted outage activity. Because outage-producing wind speeds can vary based on exposure, topography, directionality, vegetation, seasonality, and other factors, no single criteria exists for what can constitute an outage-producing wind. However, certain general relationships have been

established in SOPP that allow PG&E to project ranges of wind speeds that produce outage activity.

Conclusion

The ultimate goal of PG&E's fire danger rating system is to further reduce the risk of fire ignitions caused by utility operations. PG&E has followed a path based on SDG&E's in its development and testing of a more streamlined fire danger index. When fire danger ratings are very high or above in any fire danger rating area, a number of mitigating measures can go into effect. These may include, but are not limited to, disabling automatic reclosing, limiting any type of hot work, prohibiting off-road travel, and the evaluation of real-time and forecast conditions for a PSPS.

PACIFIC GAS AND ELECTRIC COMPANY
ATTACHMENT B
CRITICAL SERVICES

ATTACHMENT B

Critical Services

The California Public Utilities Commission currently defines “essential customers” as those that are exempt from rotating outages and has established a process for customers to apply for essential customer status. For purposes of Public Safety Power Shut-Off (PSPS) events, Pacific Gas and Electric Company (PG&E) has a separate process for identifying customers that provide “critical services” such as first responders, health care facilities, operators of telecommunications infrastructure, and water agencies/utilities. PG&E prioritizes customers providing critical services for restoration and communication during PSPS events.

Because the Administrative Law Judge Ruling¹ requiring a list of entities considered essential services is addressing PSPS events, PG&E is using the definition of “critical” services in this Attachment. For the sake of customer privacy, PG&E provides a list of categories for the entities that would qualify as providing critical services, instead of specific customer names. Entities are listed in order of priority for restoration and communication during a PSPS event.

Critical First Responders:

- Immediate Response Needs – Police Stations
- Immediate Response Needs – Fire Stations
- 911 Dispatch Centers

Healthcare facilities:

- Immediate Response Needs – Hospitals and Surgical Centers
- Kidney Dialysis / Blood Organ Banks
- General Hospitals and Skilled Nursing Facilities

Telecommunications Infrastructure:

- Immediate Response Needs – Critical Telecom Infrastructure

Water Agencies/Utilities:

- Water Treatment Facilities
- Sewage Plants

¹ Administrative Law Judge's Ruling on Wildfire Mitigation Plan Template, and Adding Additional Parties as Respondents, issued January 17, 2019 in R.18-10-007.

Others:

- Emergency Operation Centers (Federal, State, County)
- Schools
- Prisons and Jails
- Government agencies essential to national defense
- Major evacuation centers/Shelters
- Major local public transportation centers (Bay Area Rapid Transport, ferries)
- Major national public transportation centers (airports)
- Local/state/national government staging sites

PACIFIC GAS AND ELECTRIC COMPANY
ATTACHMENT C
DESCRIPTION OF ROUTINE FACILITIES INSPECTIONS

ATTACHMENT C

Description of Routine Facilities Inspections

1. Routine Distribution Line Inspection

The Overhead Patrols and Inspections Program, focused on safety and reliability, is designed to comply with General Orders (GO) 95 and 165, resulting in inspections of Pacific Gas and Electric Company (PG&E) electric facilities to identify conditions that may pose a hazard or the risk of an ignition. The Overhead Patrols and Inspections Program is primarily focused on the identification, assessment, prioritization, and documentation of abnormal conditions (e.g., conditions that could impact safety or reliability such as damaged or missing critical components), regulatory conditions (e.g., specific field conditions PG&E has determined must be identified regardless of impact to safety or reliability, such as missing high voltage signs), and third-party caused conditions that negatively impact safety or reliability (e.g., unauthorized attachments, structures built too close to facilities). These conditions may occur due to operational use, degradation, deterioration, environmental changes, or third-party actions.

In addition, there are several preventive and corrective maintenance programs that are focused on maintaining assets, replacing assets or targeted service reliability improvements, such as the Pole Test and Treat Program and line equipment inspections and testing. Consistent with GO 165, there are three defined levels of these routine distribution line inspections as follows:

- A patrol inspection is a simple visual inspection, of applicable utility equipment and structures, that is designed to identify obvious structural problems and hazards. Patrol inspections may be carried out in the course of other company business. Overhead patrols of equipment and conductors are required to be completed every year in High Fire Threat District (HFTD) areas.
- A detailed inspection is where individual pieces of equipment and structures are carefully examined, visually and through use of routine diagnostic tests, as appropriate, and (if practical and if useful information can be so gathered) opened, and the condition of each rated and

recorded. Overhead detailed inspections of equipment and conductors are required to be completed every five years in HFTD areas.

- An intrusive inspection is defined as one involving movement of soil, taking samples for analysis, and/or using more sophisticated diagnostic tools beyond visual inspections or instrument reading. For wood poles that are over 15 years old and have not been previously subjected to intrusive inspections, an intrusive inspection must be performed. For wood poles that have previously passed an intrusive inspection, the follow-on intrusive inspection interval is 20 years.

PG&E's programs are designed to meet or exceed the GO 165 minimum requirements in HFTD areas. For example, PG&E performs intrusive inspections on wood poles that have previously passed an intrusive inspection approximately every 10 years or if conditions call for testing.

In addition to identifying and resolving immediate safety or reliability hazard conditions, a Compliance Inspector is required to identify and document the field scenarios that impact safety and reliability. All overhead assessments must be performed using visual observations and may also include diagnostic testing (e.g., hammer sound test, bore tests) to verify pole integrity. The work resulting from the GO 165 inspection program is prioritized based on several factors when evaluating an abnormal condition, including both the probability and impact of a failure or exposure to the public or workers. PG&E's Distribution organization is directed to identify deficient conditions, create corrective notifications, and assign priority as described in Section 4.2 of the Wildfire Safety Plan.

2. Routine Transmission Line Inspection

Similar to the role of inspections and patrols for electric distribution, inspection and patrol procedures are a key element of the preventive maintenance program for PG&E's electric transmission lines. These actions reduce the potential for component failures and facility damage and facilitate a proactive approach to repairing or replacing identified, degraded or damaged components. PG&E's transmission procedures include the following regular transmission inspection activities:

- A patrol inspection is a visual observation to identify abnormalities (e.g., obvious structural problems or hazards) or circumstances that will

negatively impact safety. All overhead transmission line facilities are patrolled annually. An overhead patrol may be performed by walking, driving, or flying (helicopter only), and are conducted in a manner that will identify deficient conditions.

- A detailed inspection is a visual observation of individual components, structures and equipment; operational readings; and component testing (e.g., hammer test) to identify abnormalities or circumstances that will negatively impact safety, reliability, or asset life. Detailed inspection frequencies vary depending on voltage, structure type (wood or steel), and foundation location relative to bodies of water. A detailed ground, aerial, or climbing inspection of the asset looks for deficiencies or circumstances that will negatively impact safety, reliability, or asset life. Individual elements and components are examined carefully through visual and/or routine diagnostic tests, and each abnormal condition is graded and/or recorded.
- An infrared inspection uses infrared cameras, affixed to helicopters, to capture heat data of individual components to identify deficiencies requiring further attention. Infrared inspections may be performed in conjunction with overhead inspections, but must not be considered as, or substituted for, an overhead inspection. Infrared inspections are performed annually in Tier 3 HFTD areas and every three years in Tier 2 HFTD areas. Infrared inspections are performed in late spring or early summer when line loading and favorable weather facilitates effective infrared readings.
- A non-routine patrol or inspection may be conducted on an ad-hoc basis given conditions including, but not limited to, storm restoration.

PG&E's Transmission organization identifies deficient conditions, creates corrective notifications, and assigns priority as described in Section 4.2 of the Wildfire Safety Plan.

3. Routine Substation Inspection

PG&E's Substation Inspection Program uses a time-based inspection interval. Routine substation inspections are scheduled to be performed based on the substation type.¹ For example, Type 1 is monthly, and Type 2 is every other month. The type and frequency are based on the substation criticality matrix that PG&E developed utilizing industry best practices. PG&E evaluates the risk of each substation based upon public and employee safety, system criticality, security, and environmental risk.

The Substation Inspection Program activities include:

- Inspecting the substation and equipment for damage or abnormal conditions.
- Inspecting all other items appropriate to the substation and its equipment.
- Documenting and reporting any abnormal conditions found in the substation and documenting any repairs, services or other work performed.

At a minimum, qualified personnel perform a visual and/or auditory (if applicable) inspection of substation equipment and facilities, whether in service or not, in compliance with GO 174 requirements. PG&E's Substation organization identifies notable conditions, creates corrective notifications, and assigns priority as described in Section 4.2 of the Wildfire Safety Plan.

¹ The Substation Inspection Program does not include maintenance work such as unplanned or corrective maintenance, on-line condition monitoring, infrared and corona inspections or testing.

PACIFIC GAS AND ELECTRIC COMPANY
ATTACHMENT D
RISKS AND DRIVERS IDENTIFIED IN RAMP

ATTACHMENT D

Risks and Drivers Identified in RAMP

As discussed in its 2017 Risk Assessment Mitigation Phase (RAMP) Report, Pacific Gas and Electric Company's (PG&E) total expenditure in 2016 for all wildfire risk-related activities was approximately \$750 million.¹ Most of this expenditure, about \$435 million, was directed to vegetation management (routine and drought and tree mortality work) around PG&E's overhead transmission and distribution lines, the biggest driver of wildfire risk for distribution lines, primarily in areas that are now designated as High Fire Threat District (HFTD) areas.² Other expenditures and infrastructure replacement programs to control wildfire risk included patrols and inspections of PG&E's overhead electric facilities; preventive maintenance of equipment and poles; replacement of overhead conductor, overhead distribution equipment, and poles that are at risk of failing; installation of protective equipment (e.g., fuses and reclosers) that isolates circuit segments when abnormal conditions are detected; funding of local Fire Safe Councils³ for fire detection and fuel reduction projects in local communities; and the development and enhancement of engineering design standards, training, and operational procedures to minimize wildfire risk. PG&E refers to these existing programs as "controls."⁴ The table below provides a list of these controls identified in the 2017 RAMP Report, followed by a description of each control.

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- ¹ See 2017 RAMP Report, Chapter 11, Wildfire, Section III, Table 11-1.
 - ² As described below, the California Public Utilities Commission (Commission) has recently changed its classification system for high fire-threat areas. Some areas previously classified as high fire-threat areas were not included in the Commission's HFTD Map.
 - ³ Fire Safe Councils are community-based, self-governed groups that focus on fire safety. They distribute fire safety materials, teach fire-safe home construction techniques, conduct fuel reduction projects, fund defensible space projects around homes and escape routes, sponsor lookout towers, and form community safety networks.
 - ⁴ For definition purposes in this Wildfire Safety Plan (Plan or WSP), PG&E considers "controls" to be safety or compliance programs already in place, though not necessarily included in prior GRC-approved budgets, and "mitigations" to be specific additional or enhancement programs with primary goals beyond compliance, with specific start and end dates and a project budget, or an additional proposed activity not previously identified.

Wildfire Risk Controls

Line No.	Control #	Control
1	C1	Overhead Patrols and Inspections
2	C2	Vegetation Management
3	C3	CEMA Vegetation Management
4	C4	Non-Exempt Equipment Replacement
5	C5	Overhead Conductor Replacement
6	C6	Animal Abatement
7	C7	Protective Equipment
8	C8	Overhead Equipment Replacement
9	C9	Deteriorated Pole Replacement
10	C10	Wood Pole Bridging
11	C11	Design Standards
12	C12	Restoration, Operational, Procedures, and Training

- C1 – Overhead Patrol and Inspections: PG&E patrols and inspects its overhead electric facilities to identify damaged facilities and other conditions that may pose a risk of wildfire ignition. Patrols and inspections are performed annually in urban and high-risk wildfire areas, and biannually in rural areas.
- C2 – Vegetation Management: PG&E's Vegetation Management (VM) Program was developed in accordance with General Order (GO) 95, Rule 35, and Public Resources Code (PRC) Sections 4292 and 4293. The program includes inspection and identification of vegetation that poses a potential safety hazard, as well as clearing and removal of vegetation, and quality assurance. The main components of this work are the routine VM Program, vegetation control, and quality assurance.
- C3 – CEMA Vegetation Management: This control includes five initiatives intended to address the vegetation impacts associated with prolonged drought conditions. The five initiatives are as follows:
 - 1) Enhanced Vegetation Inspection and Mitigation – Additional ground and air inspection on selected circuits in high fire threat areas to further reduce the potential for changing forest conditions to result in vegetation and power line conflicts.

- 2) Wild Land Urban Interface Protection – Additional VM inspections in Local Reliability Areas (LRA)⁵ and greater clearance of poles in high fire danger LRAs.
 - 3) Fuel Reduction and Emergency Response Access – Funding Fire Safe Councils to support fuel reduction in high fire danger areas around PG&E's electric distribution facilities.
 - 4) Early Detection of Forest Disease/Infection – Forming cooperative information sharing with universities, California Department of Forestry and Fire Protection (CAL FIRE) and the USFS on forest health.
 - 5) Early Detection and Response to Wildfires – Funding fire lookouts, aerial patrols, and fire detection cameras located near PG&E's electric distribution facilities.
- C4 – Non-Exempt Equipment Replacement: The planned replacement of equipment non-exempt from PRC 4292 requirements with exempt equipment. Exempt equipment is identified by CAL FIRE as having lower fire risk.
 - C5 – Overhead Conductor Replacement: Programs under which overhead conductor is either proactively replaced through a targeted program or replaced after a failure occurs. Conductor replacement work in high-risk wildfire areas and conductor with higher likelihood of failure is prioritized.
 - C6 – Animal Abatement: The installation of new equipment or retrofitting existing equipment with protection measures intended to reduce animal contacts. This includes avian protection on distribution and transmission poles, such as jumper covers, bushing covers, perch guards, or perching platforms.
 - C7 – Protective Equipment: The installation of new equipment (e.g., fuses, reclosers, and SCADA installations) that isolates equipment when abnormal system conditions are detected.
 - C8 – Overhead Equipment Replacement: Proactive identification and replacement of critical, deteriorating overhead distribution equipment, such as cross-arms, transformers, capacitors, reclosers, and switches. Equipment is identified through the Patrol and Inspections control (C1) or through *ad hoc* inspection.

⁵ LRAs are areas where primary responsibility to respond to fires rests with local authorities, e.g., fire departments.

- C9 – Deteriorated Pole Replacement: The identification and replacement of deteriorated wood distribution and transmission poles, including intrusive inspection work (pole test and treat) and replacement or remediation. GO 165 mandates testing on a 20-year cycle depending on the installation date. PG&E’s program tests poles approximately every 10 years—exceeding the inspection cycle compliance requirements—and incorporates wood preservation practices that also go beyond compliance. These factors allow PG&E to identify and mitigate the decay of wood which reduces failures.
- C10 – Wood Pole Bridging: The installation of a wire which connects the through-bolt of all phases of a distribution wood pole in order to reduce the probability of a pole fire occurring due to current traveling through the wooden cross arms. These pole fires tend to occur after a light rain due to possibility of increased leakage currents through the insulators.
- C11 – Design Standards: The general standards for proper application of equipment for safe and reliable operation.
- C12 – Restoration, Operational Procedures and Training: The procedures contained in Utility Standard TD-1464S⁶ and Utility Bulletin TD-1464B-001⁷ for increased Wildfire controls when a FIA has a rating of Very High, Extreme, or Extreme Plus.

⁶ Utility Standard TD-1464S “Fire Danger Precautions in Hazardous Fire Areas” establishes precautions when working, travelling, or operating in hazardous fire areas.

⁷ Utility Bulletin TD-1464B-001 “Fire Index Patrol and Non-Reclose Process” contains PG&E’s reclosing device operating practices in effect in 2018.

PACIFIC GAS AND ELECTRIC COMPANY
ATTACHMENT E
COST ESTIMATES FOR 2019 PLAN PROGRAMS

Attachment E: Cost Estimates for 2019 Plan Programs

Plan Section	Program/Strategy (§8386(c)(3))	Mapped Programs	Asset Addressed: Pole, Line, Equipment	Estimated Annual Cost: 2019 Capital (1,000s)	Estimated Annual Cost: 2019 Expense (1,000s)	Costs Currently Reflected in Revenue Requirement? (Provide Decision Reference) If for Only Part of Budget, Identify the \$ for that Part and Explain Part Not Previously Authorized (§ 8386(j))		Identify any Aspects of Plan/Strategy and Associated Funding That Is or Will Be Addressed in Another Case (Identify the Case) (§ 8386(j))	Identify Any Memorandum Accounts Where Costs of Program/Strategy Are Being Tracked and Explain How Double Tracking Is Prevented (§ 8386(j))	Previously Included in RAMP? (Provide Reference) (§ 8386 (c) (11))	Evaluation Metric(s) (§ 8386 (c)(4))	Assumptions Underlying Metric (§ 8386 (c)(4))
						Capital	Expense					
4	Wildfire Safety Strategy and Programs											
4.0	PMO	PMO	N/A - Operations	\$500	\$8,000	N	N	None	FRMMA / WPMA	Not included	N/A	N/A
4.1	Operational Practices											
4.1.1	Recloser Operations	Reclose Blocking (Manual)	All	-	-	N/A	N/A	None	N/A	Yes, See Mitigation #M1	See Section 4, Table 9: 2019 Wildfire Safety Plan Targets	See Section 4, Table 9: 2019 Wildfire Safety Plan Targets
4.1.2	Personnel Work Procedures in Conditions of Elevated Fire Risk	N/A	N/A - Operations	-	-	N/A	N/A	None	N/A	Not included		
4.1.3	Safety and Infrastructure Protection Teams	Safety and Infrastructure Protection Team	N/A - Operations	\$6,200	\$12,300	N	N	None	CEMA	Not included		
4.1.4	Aviation Resources	Aviation	N/A - Operations	\$2,100	\$2,400	N	N	Cap: None Exp: None	Cap: FRMMA / WPMA Exp: CEMA	Not included		
4.2	Wildfire Safety Inspection Programs											
4.2.1	WSIP, Distribution	Distribution Inspection / Repair	All	\$220,000-\$620,000	\$130,000-\$200,000	Partial, GRC 2017-2019 (\$14M)	Partial, GRC 2017-2019 (\$6M)	None	FRMMA / WPMA	Not included	See Section 4, Table 9: 2019 Wildfire Safety Plan Targets	See Section 4, Table 9: 2019 Wildfire Safety Plan Targets
4.2.2	WSIP, Transmission	Transmission Inspection / Repair	All	\$282,000-\$402,000	\$162,000-\$167,000	N	N	TO	N/A	Not included		
4.2.3	WSIP, Substation	Distribution Substation Inspection / Repair	All	\$2,000-\$3,000	\$1,000-\$2,000	N	Partial, GRC 2017-2019 (\$0.5M)	None	FRMMA / WPMA	Not included		
		Transmission Substation Inspection/Repair	All	–	\$1,000-\$2,000	N/A	N	TO	N/A	Not included		
4.3	System Hardening											
4.3.1	Pole Material	Wildfire System Hardening	All	\$236,900	–	Partial, GRC 2017-2019 (\$7M)	N/A	None	FRMMA / WPMA	Partially, See Mitigation M6, M7, M8 & M9	See Section 4, Table 9: 2019 Wildfire Safety Plan Targets	See Section 4, Table 9: 2019 Wildfire Safety Plan Targets
4.3.2	Pole Materials (Transmission)	Light Duty Steel Poles for Transmission	Pole	\$500	-	N	N/A	TO	N/A	Not included		
4.3.2	Pole Loading and Replacement (Distribution)	Wildfire System Hardening	All	\$236,900	–	Partial, GRC 2017-2019 (\$7M)	N/A	None	FRMMA / WPMA	Partially, See Mitigation M6, M7, M8 & M9		

Plan Section	Program/Strategy (§8386(c)(3))	Mapped Programs	Asset Addressed: Pole, Line, Equipment	Estimated Annual Cost: 2019 Capital (1,000s)	Estimated Annual Cost: 2019 Expense (1,000s)	Costs Currently Reflected in Revenue Requirement? (Provide Decision Reference) If for Only Part of Budget, Identify the \$ for that Part and Explain Part Not Previously Authorized (§ 8386(j))		Identify any Aspects of Plan/Strategy and Associated Funding That Is or Will Be Addressed in Another Case (Identify the Case) (§ 8386(j))	Identify Any Memorandum Accounts Where Costs of Program/Strategy Are Being Tracked and Explain How Double Tracking Is Prevented (§ 8386(j))	Previously Included in RAMP? (Provide Reference) (§ 8386 (c) (11))	Evaluation Metric(s) (§ 8386 (c)(4))	Assumptions Underlying Metric (§ 8386 (c)(4))
4.3.3	Conductor	Wildfire System Hardening	All	\$236,900	–	Partial, GRC 2017-2019 (\$7M)	N/A	None	FRMMA / WPMA	Partially, See Mitigation M6, M7, M8 & M9		
4.3.4	System Protection	Automation and Protection (SCADA)	Equipment	\$15,600	\$300	Partial, GRC 2017-2019 (\$1M)	Partial, GRC 2017-2019	None	FRMMA / WPMA	Not included		
4.3.5	Equipment	Non-exempt Surge Arrester Replacement Program	Equipment	\$71,600	–	* Program shift to replace therefore cost recorded in Cap	Partial, GRC 2017-2019 (\$6M)	None	FRMMA / WPMA	Yes, See Mitigation M5		
4.4	Enhanced Vegetation Management											
4.4.1	Vegetation Trimming and Overhanging Tree Limbs	Enhanced Vegetation Management	N/A Operations	–	\$338,300	N/A	N	None	FHPMA	Partially, See Mitigation # M3 & M4	See Section 4, Table 9: 2019 Wildfire Safety Plan Targets	See Section 4, Table 9: 2019 Wildfire Safety Plan Targets
4.4.2	High Fire-Threat District VM Inspection Strategy											
4.4.3	Inspecting Trees with a Potential Strike Path to Power Lines											
4.4.4	At-risk Species Management											
4.4.5	Challenges Associated With Enhanced Vegetation Management											
4.4.6	Community and Environmental Impacts											
Other	CEMA Costs	CEMA – Drought Tree Mortality	N/A Operations	–	\$85,900	N/A	N	None	CEMA	Yes, See C1		
Other	Substation Vegetation Management	Sub Veg Mgt (T)-identified in WSIP	N/A Operations	–	\$2,000 - \$4,000	N/A	N	TO	N/A	Not included		
		Sub Veg Mgt (D)-identified in WSIP	N/A Operations	–	\$4,000 - \$5,000	N/A	Partial, GRC 2017-2019 (\$0.2M)	None	FRMMA / WPMA	Not included		
4.5	Enhanced Situational Awareness											
4.5.1	Meteorological Operations and Advanced Situational Awareness	See Programs Below	N/A Operations	–	–	N/A	N	None	N/A	Not included	See Section 4, Table 9: 2019 Wildfire Safety Plan Targets	See Section 4, Table 9: 2019 Wildfire Safety Plan Targets
4.5.2	Fire Spread Modeling	See 4.5.5	N/A Operations	–	–	N/A	N	None	N/A	Not included		
4.5.3	Weather Stations	Expanded Weather Station Deployment	N/A Operations	\$8,200	\$300	N	N	None	FRMMA / WPMA	Not included		
4.5.4	Camera Deployment Strategy	Wildfire Cameras	N/A Operations	–	\$4,600	N/A	N	None	FRMMA / WPMA	Not included		
4.5.5	Satellite Fire Detection Systems	Satellite Fire Detection System	N/A Operations	–	\$400	N/A	N	None	FRMMA / WPMA	Not included		

Plan Section	Program/Strategy (§8386(c)(3))	Mapped Programs	Asset Addressed: Pole, Line, Equipment	Estimated Annual Cost: 2019 Capital (1,000s)	Estimated Annual Cost: 2019 Expense (1,000s)	Costs Currently Reflected in Revenue Requirement? (Provide Decision Reference) If for Only Part of Budget, Identify the \$ for that Part and Explain Part Not Previously Authorized (§ 8386(j))		Identify any Aspects of Plan/Strategy and Associated Funding That Is or Will Be Addressed in Another Case (Identify the Case) (§ 8386(j))	Identify Any Memorandum Accounts Where Costs of Program/Strategy Are Being Tracked and Explain How Double Tracking Is Prevented (§ 8386(j))	Previously Included in RAMP? (Provide Reference) (§ 8386 (c) (11))	Evaluation Metric(s) (§ 8386 (c)(4))	Assumptions Underlying Metric (§ 8386 (c)(4))
4.5.6	Storm Outage Prediction Model (SOPP)	SOPP Model Automation	N/A Operations	–	\$200	N/A	N	None	FRMMA / WPMA	Not included		
4.5.7	Wildfire Safety Operations Center	Wildfire Safety Operations Center	N/A Operations	\$700	\$15,900	N	N	None	FRMMA / WPMA	Not included		
Other	Advanced Fire Modeling	Advanced Fire Modeling	N/A Operations	–	\$1,600	N/A	N	None	FRMMA / WPMA	Not included		
4.6	Public Safety Power Safety Shutoff											
4.6.1	PSPS Decision Factors	Public Safety Power Shutoff	N/A Operations	–	\$16,500	N/A	N	None	FRMMA / WPMA	Not included	See Section 4, Table 9: 2019 Wildfire Safety Plan Targets	See Section 4, Table 9: 2019 Wildfire Safety Plan Targets
4.6.2	Strategies to Enhance PSPS Efficiency While Reducing Associated Impacts											
4.6.3	PSPS Notification Strategies											
4.6.4	Re-energization strategy											
4.6.2.1	Impact Mitigation through System Sectionalizing	Granular Sectionalizing	All	\$5,200	–	N	N/A	None	FRMMA / WPMA	Not included		
4.6.2.2	Resilience Zones	Resilience Zones	All	\$10,600	–	N	N/A	None	FRMMA / WPMA	Not included		
4.6.2.3	Customer Services and Programs	N/A - Costs and program scope are still being finalized	N/A	–	–	N/A	N/A	None	FRMMA / WPMA	Not included		
4.7	Alternative Technologies											
4.7.1	Rapid Earth Fault Current Limiter Pilot Project	Rapid Earth Current Fault Limiter	All	–	\$7,000	N/A	Yes, Recovered in EPIC	EPIC	N/A	Not included	See Section 4, Table 9: 2019 Wildfire Safety Plan Targets	See Section 4, Table 9: 2019 Wildfire Safety Plan Targets
4.7.2	Enhanced Wires Down Detection Project	Enhanced Wire Down Detection	Equipment	\$2,100	\$200	N	N	N	FRMMA / WPMA	Not included		
4.7.3	Other Alternative Technologies	N/A	N/A	–	–	N/A	N/A	None	N/A	Not included		
4.8	Post Incident Recovery, Restoration and Remediation											
4.8.1	Post-Incident Recovery	N/A	N/A	–	–	N/A	N/A	None	N/A	Not included	N/A	N/A
4.8.2	Restoration	N/A	N/A	–	–	N/A	N/A	None	N/A	Not included	N/A	N/A
4.8.3	Remediation	N/A	N/A	–	–	N/A	N/A	None	N/A	Not included	N/A	N/A
Other	Support											
Other	IT Costs	N/A	N/A - Operations	\$16,000 - \$33,000	\$13,000 - \$18,000	N	Partial	TO	FRMMA / WPMA	Not included	N/A	N/A